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OVERSIGHT ON IMPLEMENTATION OF THE ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION (AARC) ACT OF 1990

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HEARING

BEFORE THE

SUBCOMMITTEE ON
AGRICULTURAL RESEARCH, CONSERVATION,
FORESTRY, AND GENERAL LEGISLATION

OF THE

COMMITTEE ON AGRICULTURE,
NUTRITION, AND FORESTRY
UNITED STATES SENATE

P61-50

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

ON

OVERSIGHT ON IMPLEMENTATION OF THE ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION (AARC) ACT OF 1990

APRIL 29, 1993

Printed for the use of the
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OVERSIGHT ON IMPLEMENTATION OF THE ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION (AARC) ACT OF 1993

THURSDAY, APRIL 29, 1993

U.S. SENATE, SUBCOMMITTEE ON AGRICULTURAL RESEARCH, CONSERVATION, FORESTRY AND GENERAL LEGISLATION OF THE COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:03 a.m., in Room SR-332, Russell Senate Office Building, Hon. Thomas A. Daschle presiding.

Present or submitting a statement: Senators Daschle, Conrad and Harkin.

STATEMENT OF HON. THOMAS A. DASCHLE, A U.S. SENATOR FROM SOUTH DAKOTA

Senator DASCHLE. The hearing will come to order.

Let me thank all of our witnesses this morning for agreeing to participate in what I hope will be another productive session this morning, talking about an issue of great interest and concern. A number of other Senators have expressed interest in coming by, and I am sure they will be here shortly.

In many parts of the country, agriculture and rural communities face dire circumstances. Declining commodity prices, increasing agricultural imput costs, ongoing environmental concerns, and the loss of jobs from rural communities all add up to a very serious situation in rural America. To compound this problem, budgetary constraints within the Government continue to chip away at agricultural support programs. A wheat farmer having few or no options for producing alternative crops could lose 360 percent of his net cash income under current plans to reduce the acreage for which farmers receive support. Something must be done, and short-term solutions are not the total answer.

Historically, most American farmers have had more cropping alternatives and produced a more diverse number of crops than they currently do. In the Midwest, for example, climactic and market forces have led to the mono- or bi-culture cropping systems that are prevalent today, such as wheat-wheat, corn-corn or corn-soybean systems. Alfalfa used to be a prominent crop throughout the Midwest, but the dairy industry has moved from the region and took with it the economic viability of producing alfalfa in midwestern cropping systems.

Most nonchemical sustainable agricultural approaches for weed and pest control are not effective in these mono-culture cropping systems. Diverse crop rotation, preferably a five- to seven-year rotation, is one of the oldest and, in my view, best methods of sustainable agriculture. Rotational cropping systems keep soil fertile and suppress both weed and insect pests and soil diseases, and thereby substantially reduce the need for chemical inputs.

In an economic sense, mono-culture systems force producers to "put all their eggs in one basket." The recent corn disaster makes this reality all too clear. A 1992 bumper corn crop resulted in declining prices, and weather conditions reduced corn quality and/or prevented harvest for many of our Nation's producers, including many in my State. For those producers relying primarily on income from their corn crop to meet their obligations, the economic situation is very bleak. Such dire disasters could be averted if a producer's crop base and, in turn, their income base, was more diverse. Conditions that reduce corn quality may not adversely affect an equally profitable biomass crop. The key here is that cropping alternatives must contribute to and enhance the economic viability of the farm.

There is no question that agriculture is on the brink—the brink of disaster. Moving forward into the 21st century will require sound environmental practices, and the ability to meet the food, fiber and even industrial needs of our expanding American and world economies. New uses, or industrial uses of existing agricultural crops, as well as industrial uses for new crops, have the potential to provide long-term solutions to many of the problems faced by our agricultural sector today. New uses and new crops will permit environmentally sound rotational cropping systems and provide new economic opportunities through increased farm income and income diversity, increased rural employment, a strengthened rural infrastructure, reduced dependence on imports, and enhanced U.S. competitiveness in international markets. Agriculturally based products, such as ethanol produced from "biomass," fully degradable "bio" substitutes for petroleum-based plastics, biodiesel fuels, and vegetable-based industrial oils, to mention a few, replace imports, or products made from imports, address environmental concerns, and reduce the use of nonrenewable raw materials.

In recent years, there has been a growing recognition of the potential economic benefits that would accrue from a more diversified utilization of agricultural commodities. The Alternative Agricultural Research and Commercialization Act was introduced in the 1990 farm bill as part of an effort to encourage research, development and commercialization of new nonfood, nonfeed uses of new and traditional agricultural commodities. The legislation authorized the creation of the AARC Board and charged the Board with the responsibility to develop AARC policies and programs.

It has been just over a year since the AARC Board was established, and about seven months since our last AARC oversight hearing. During the first six months of its existence, the Board completed a series of regional hearings and published a request for pre-proposals. Since the last oversight hearing, the Board has developed and published its five-year strategic plan, progressed from requesting pre-proposals to negotiating funding for successful proposals, received proposals for AARC regional centers and begun deliberation on where to locate these AARC regional centers.

The purpose of this oversight hearing will be to review the Board's activities over the past year, particularly the activities of the past seven months, and to determine the extent to which the Board has successfully implemented the congressional intent of the AARC Act of 1990. We hope to hear testimony from the Board summarizing what has occurred over this last year, focusing on events since the last hearing. Specifically, we are interested in a report on the criteria and process by which pre-proposals and proposals were evaluated and awarded, the impact that funded projects will have on agriculture and rural communities in terms of creating economic opportunity and rural infrastructure development, the progress being made by the Board on the creation of the AARC regional centers and the role the Board expects these regional centers to play.

We will also hear a report on the AARC Board's five-year strategic plan, which was published since the last oversight hearing, and discuss the implications of that document in terms of agriculture and rural communities.

Additionally, we will hear from a broad range of witnesses, with varying degrees of involvement with the AARC Center, who will provide their perspectives and review the AARC Board's activities to date.

Obviously, it is a full agenda, and one that I hope will bring us up to date and set the record for progress made thus far. I hope that we will lay out with some clarity the prospects and the opportunities that lie before us in the coming months.

No one has had a greater impact or played a more consequential role in the creation of AARC and in following through with the potential of opportunities related to AARC than my dear friend and colleague, the Senator from North Dakota, and at this time I would ask if he has any opening remarks.

STATEMENT OF HON. KENT CONRAD, A U.S. SENATOR FROM NORTH DAKOTA

Senator CONRAD. Thank you, Mr. Chairman.

I have a statement that I would have made part of the record.

This is an exciting moment, because we are about to have our first hearing to learn the details of the projects that have been approved by the AARC Board and to try to ascertain if the potential that all of us believe existed in the creation of AARC are going to be realized.

Mr. Chairman, I think instead of my making a more detailed statement, I would just say that I believe that AARC has the potential not only to do a great deal for agriculture and for rural America, but also to serve as a model for other sectors of the economy.

One of the things that we know is that we do a great job of production agriculture, and we do a great job of basic research. What we have not done so well is to commercialize the outstanding research done across this country. What we have not done so well in other sectors as well is to commercialize the outstanding discoveries that have been made in basic science.

Our hope and our dream is that, with respect to commercializing of these products that have been developed and researched, that we are going to have a whole new opportunity open up for American agriculture.

I want to thank you, Mr. Chairman, for holding this hearing. I want to thank the AARC Board for the exceptional job that I believe has been done thus far and to say that we very much hope that these projects that have been selected will prove successful, because then we will have a base to build on that will encourage further support from the administration and from the Congress and also I think serve as a model for other industries, as well.

[The prepared statement of Senator Conrad follows:]

PREPARED STATEMENT OF HON. KENT CONRAD, A SENATOR FROM SOUTH DAKOTA

Mr. Chairman, thank you for holding this hearing to review the implementation of the Alternative Agricultural Research and Commercialization (AARC) Act of 1990. I am looking forward to the testimony of the witnesses about the progress of the AARC Center and the commercialization of new uses. I am particularly eager to hear more about the projects that the AARC Board has recently selected for its first round of funding.

I had very clear objectives in mind as I developed and achieved enactment of AARC with the help of Senators Daschle and Harkin, and Congressman Penny.

One, I wanted to target assistance on the establishment of new uses commercialization businesses which would be located in rural areas, and which would create new jobs and income in, and otherwise benefit, rural areas.

Two, I wanted to ensure that we only assisted commercialization projects which would truly benefit farmers by increasing the prices for raw agricultural commodities. It makes no sense to provide Government assistance for projects which can only produce a competitive new uses product if the raw material is purchased at below its cost of production.

Three, I want AARC to provide actual business financing, including loans and venture capital, to start up new uses businesses.

Four, I wanted to focus AARC's assistance on businesses, particularly small businesses, that did not have adequate resources to commercialize new uses on their own, but rather needed AARC assistance in order to leverage other sources of financing.

Five, I wanted to use AARC to link the myriad of public and private programs and resources around the country which can contribute to the establishment of new uses businesses. While separately these programs cannot provide all the kinds of assistance and financing necessary to commercialize new uses, together they are a powerful resource.

I will be interested in discussing how well the AARC Center has been able to meet my objectives. In particular, I would like to learn what criteria it is using to ensure it selects commercialization projects which meet these objectives.

I also feel very strongly about the importance of establishing AARC Regional Centers to provide hands-on assistance to new uses businesses projects. This hands-on assistance is essential to the successful establishment of these new businesses. I hope to learn about the progress of the AARC Board in reviewing the Regional Center applications that it received in February.

I want to welcome the witnesses and again, thank you, Mr. Chairman, for holding this hearing.

Senator **DASCHLE**. Thank you, Senator Conrad.

We are going to attempt to create sort of a panel discussion throughout the hearing this morning, and it is in light of that intent that I am going to be calling all of our witnesses to the table for their testimony and then a discussion following the testimony. Let me begin by listing them. I would invite them to come to the table at this time.

Dr. Paul O'Connell, the Director of the Alternative Agricultural Research and Commercialization Center; Mr. Lee Reeve, Producer

Representative of the AARC Board; Dr. Gary Jolliff, a professor at Oregon State University; Mr. Jeff Gain, Chairman of New Uses Council, and Chief Executive Officer of the National Corn Growers Association. I understand he may be accompanied by Randy Cruise. Is Randy here?

Mr. **Gain**. He is home planting corn.

Senator **Daschle**. Well, that is where he should be. [Laughter.]

Mr. Mark Carver, Vice President and General Manager of Arkenol, from California; Mr. Michael Riebel, the Executive Vice President of Phenix Composites, in Minnesota; Mr. Bob Herzfeld, the Marketing Manager of Cenex/Land O'Lakes; and Mr. Mark McAfee, the Assistant to the Executive Director of the Agricultural Utilization Research Institute.

Gentlemen, thank you all for coming. Some of you have come a long way and we appreciate your participation this morning and your continued interest and leadership in this most important area.

Let me begin with Dr. O'Connell, and we will proceed as I have listed the witnesses just now.

Dr. O'Connell.

STATEMENT OF PAUL F. O'CONNELL, DIRECTOR, ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION CENTER, U.S. DEPARTMENT OF AGRICULTURE, WASHINGTON, DC

Mr. **O'Connell**. Thank you, Mr. Chairman.

I am pleased to be here. This is an exciting topic that we all feel very excited about and feel that it is going to result in some worthwhile jobs and economic activity out in rural America.

Mr. Chairman and members of the committee, as Director of the AARC Center, I appreciate this opportunity to discuss the progress the Center has made since my appearance before you last September.

In particular, I want to bring you up to date on our selection of projects to be funded, as well as the status of our site selection for some of the regional centers.

In September of 1992 testimony before you, I speculated that the center would receive about 250 pre-proposals. By the October 30th deadline, we had in fact received 407, I think which indicates the tremendous amount of interest out across the country in this kind of activity.

In November, the pre-proposals went through a comprehensive review process in line with the enabling legislation and guidelines from the Board. Three outside specialists, including at least one with business experience and another with technical knowledge, plus the AARC Center staff reviewed each pre-proposal. After considering reviewers' individual comments and using their respective judgment, AARC Board members met in December and selected 48 for further consideration, and those 48 were actually full proposals which are rather detailed as to the information that we were asking for folks.

On the next page of my testimony and half of the following page, it goes into some detail as to the kind of information that we requested. I won't go into that now. It is part of the record, and I will just jump over it to the bottom part of page three.

The full proposals were submitted in February of this year. In total, the 48 proposals requested $30 million in funding. The AARC Center has about $10 million to provide for projects this year. The Board rank-ordered the proposals and is currently negotiating with the top 22 for final funding. At least one Board member and staff person made a site visit to each project location. The purpose of these visits was to ensure that what was presented on paper actually existed on the ground, and to correct any deficiencies the individual reviewers or Board members saw in the proposals and to negotiate payback arrangements.

The 22 projects selected for final negotiations by the Board involved 14 different plant and animal materials. Mr. Chairman, I think that begins to address some of the concerns you had in your opening statement in regard to diversity of crops and diversity of materials that we are looking at.

They include animal fat, kenaf, waste paper, corn starch, soy meal and oil, industrial rapeseed or crambe, wheat, lesquerella, hesperaloe, grass straw and lodgepole pine. That is the nature of the projects that we are looking at funding right now, and a very diverse cross-section of products will be coming out of those projects.

They include composite building material that looks like polished granite, pulp, automotive windshield washer fluid using ethanol, biodiesel, grass mats, degradable polymers for food packaging, personal care items and medical products, biodegradable lubricants, and a concrete form release agent. I believe that these will set up products that are environmentally friendly and create demand for biodiversity on the farm.

I have in the back of us here, you can see it along this shelf, a whole diverse kind of indication of the kind of projects we are talking about, and it is the sort of things I just went through right here, indicating diversity of the products and the projects that we are working on. I won't go through in detail.

One thing I would like to do, though, and Jeff likes to do these experiments—I have a little different one, though, Jeff.

Mr. GAIN. I am watching.

Mr. O'CONNELL. This is one from oil seed crop, crambe and rapeseed, and everyone always says—you hear it from when you are very small—that oil and water don't mix. Well, they haven't looked at a product like this here. By the way, I am stirring this with a starch-based—hopefully, it doesn't disintegrate when I am doing it. [Laughter.]

But you see that it's an emulsifier in there and you see it comes out like that, and that is the kind of an oil that they are using this for cutting oil, but you can also use this in a marine environment or a forest environment. It will break down much quicker. It will biodegrade the natural things, the bacteria and fungi and so forth, can break this down much better than petroleum-based oil, so it has tremendous implications.

So when somebody tells you oil and water doesn't mix—now, this will stay like this, this won't drop out, but it allows it to breakdown, like I say, the fungi and so forth to get at this a whole lot quicker.

Testifying at today's hearing are representatives from projects we are currently negotiating with to finalize.

I just want to touch on a few others that I think are important. One is Aquinas Technologies Group from St. Louis, Missouri. This small firm currently sells a standard petroleum-based windshield washer fluid. Working with the National Corn Growers Association and Goodwill Industries—and I found this a very interesting partnership. Goodwill Industries are trying to employ people that are handicapped and so forth, and in combination with them, they have set up assembly lines to produce this windshield washer fluid.

They put in a proposal and, rather than getting it from methanol, they get it from ethanol, of which, of course, we produce either from corn or cellulose material, thus producing a product which is domestically produced, environmentally friendly and safer. The current methanol-based windshield washer fluid can be toxic if consumed. The denatured ethanol would not be.

The total domestic market of windshield washer field is $120 million, which is derived from corn, and would amount to 24 million bushels of corn, so we are not talking about a small volume product here. Everyone, especially the folks here from Minnesota, you use a little bit of windshield washer fluid, I believe. So it is a tremendous example of a new product opportunity. I wish I had thought of it myself.

Another example is with Midwest Grain Products, from Atchison, Kansas. This company is a successful agribusiness that processes and markets beverage spirits, industrial alcohol, distill grain feeds, wheat gluten and wheat starch, a very aggressive company and has a number of products out there.

They see an opportunity to develop and market wheat gluten-based plastic substitutes that are more stable and water resistant than the starch-based materials of which this is. In other words, the products that they are talking about are products that will be more resistant and be more stable in use, which these are not. So we are talking about coated films, plates, molded plastics and so forth. But a specific application we talked about was for coating of corrugated boxes for transporting fruits and vegetables. They use wax primarily now that isn't too good. So these are just two of the projects we're supporting. There are a number of other ones.

Based on my experience with other USDA programs—sustainable agriculture and aquaculture—having regional administrative centers can save program dollars, especially when the host institutions must share the costs of operating the center.

When competitive programs are run from Washington, DC, costs are higher for the following reasons: Business and panel review members must come to Washington, a high-cost area, at program expense; program support is more expensive, because there is more competition for office space and qualified people in Washington; and there is greater opportunity for more direct interaction with project partners.

So really I see in the programs that I have been working with in the past, especially sustainable and aquaculture, you can really save money by having regional centers, rather than costing money, because that concern comes up a great deal, especially in the administration and others. But having just an administrative center and not a center with walls, it can save us money.

Considerable interest exists for hosting regional centers. I would say we have gotten inquiries on a lot of projects, whether there is funding or not, and so forth. But in all honesty, one of the areas of tremendous interest is being a regional center host.

We see that it would be grass roots "eyes, ears and mouth" for the AARC Center; establish a network of processors, marketers, producers, scientists and financiers to identify opportunities; serve as "circuit riders" to form project partnerships; recommend the best opportunities to commercialize new nonfood, nonfeed products; and after going through a competitive review process—as designed by the AARC Board—make recommendations concerning regional centers that should be funded.

Decisions on where regional centers will be located will be based on the following criteria: ability to fully share the administrative costs; qualifications to carry out the regional center activity; geographic distribution; and enthusiasm, desire and creativity demonstration in doing this.

On December 23, 1992, the Board's request for proposals to host a regional center was published in the Federal Register. The Center received 14 proposals by the due date of February 19th. On May 19th, the Board will meet here in Washington. We anticipate that one of the results of the meeting will be the announcement of the location of the first two regional centers, and we will more or less lay out the geographic areas for the others.

As indicated in the budget language of the 1993 budget, it is indicated that we could only start out with two regional centers, and then later on, hopefully next year, we will have all six of them, but we will be discussing that in the Board. So that is where we are at on the regional centers.

The uniqueness of the AARC Center: A question that came up on the House side when we had our budget hearings was what is different about AARC as compared to ARS, CSRS and the Forest Service. Unlike ARS, CSRS and the Forest Service, the AARC Center's main focus is on closing the gap between promising research results and commercialization.

Rather than duplicating the work of these agencies, the Center role complements the work of researchers in other agencies by providing a vehicle for getting their research results to the market more rapidly. Indeed, the complementary nature of the AARC Center's support can be seen in the number of requests it received to support projects that drew on research work initially funded by these agencies.

However, the projects the AARC Center is funding also draws on research conducted by private firms and foreign countries, and that is a very important point. We are not just looking at the research as coming out of USDA or out of universities. We, quite frankly, don't care where it comes from. We are interested in taking the most promising ideas, working with private firms, with them in the lead, and making these projects work.

Also, unlike other USDA programs, the AARC Center provides financial assistance through partnership arrangements, which involves sharing the risk and recovering taxpayer investment. Traditional ARS agreements, known as CRADA's, involve no transfer of funds and, hence, no significant sharing of financial risk. Also, ARS enters into a CRADA only when the research objective is commensurate with the agency's mission.

The AARC Center is different from the various technology transfer programs located at some universities. Using the Iowa State program as an example, they help to transfer technology from the university to industry—approaching the issue from the technology development side. We want to see a proposal when the players are at the pre-commercialization stage.

Put more succinctly, the AARC Center's signals come from the demand side, i.e., working in partnership with a private company and developing promising technologies that already have a clearly identified market. That is the core of where we are coming from. That is distinctly different from the work of other USDA and university organizations that are involved in the earlier stages of the process, where they are conducting research to identify potential technologies which may or may not have any commercial value.

Finally, the AARC Center policy and program decisions are made by a Board of Directors with vast business, management, manufacturing and marketing experience. Often, individuals from public entities have only a strong technical background. On average, over the past year, the AARC Center Board members have devoted over 25 days of their valuable time to the center. The Board envisions the AARC Center as an innovative way for the Government to conduct business. In other words, the Board members, even as busy as they are, have taken this assignment very serious I think from a public service standpoint, that this is something they want to happen in agriculture and have given their time to make it happen.

My concluding remarks: I am very confident that the AARC Center will have a bright and productive future. Our present efforts to use agriculture as a source of industrial products traces its roots to the so-called "Chemurgic Movement," begun in the 1930's. Championed in those days by Wheeler McMillen, Thomas Edison and Henry Ford, the early days of the movement resulted in the early establishment of the four ARC regional research laboratories. A number of factors have come together in our present time, however, to move the industrial use of agricultural products beyond the research stage.

There are some critical things that have happened to make it possible. I have four fundamental reasons here: 1) We have more efficient technologies for processing and manufacturing—biotechnology, continuous fermentation and new chemical catalytic processes. In other words, we can convert renewable materials more efficient now than we could before; 2) environmental and regulatory requirements for clean air and water, landfill alternatives, disposability and renewability, the whole regulatory arena, like the Clean Air Act, are creating a situation that puts renewable materials in a good light; 3) availability of skilled labor and resources in rural America. People want to work. They want to do things. They want to create economic activity; and 4) increased pressure to reduce agricultural subsidies.

I believe the AARC Center can live up to its motto of "make it happen" and turn market potential into market reality.

I just have one other point I want to make with regard to opportunities. A new book, I just became aware of it yesterday, is called "The Carbohydrate Economy." It is put out by the Institute for Local Self-Reliance, and, I will tell you, it is one of the finest up-to-date analysis of what the opportunities are that I have seen, and I will make sure that it is made a part of the record, that the Senate has a copy of this.

[The publication referred to is retained in the committee file.]

With that, I would like to conclude my testimony, Mr. Chairman.

[The prepared statement of Mr. O'Connell follows:]

PREPARED STATEMENT OF PAUL F. O'CONNELL, DIRECTOR, ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION CENTER, U.S. DEPARTMENT OF AGRICULTURE, WASHINGTON, DC

Mr. Chairman and members of the committee. As Director of the AARC Center, I appreciate this opportunity to discuss the progress the Center has made since my appearance before you last September. In particular, I want to bring you up to date on our selection of projects to be funded, as well as the status of our site selection for some of the regional centers.

EVALUATING THE PROPOSALS

In my September 1992 testimony before you, I speculated that the Center would receive about 250 pre-proposals. By the October 30th deadline, we had in fact received 407.

In November, the pre-proposals went through a comprehensive review process in line with the enabling legislation and guidelines from the Board. Three outside specialists, including at least one with business experience and another with technical knowledge, plus the AARC Center staff reviewed each pre-proposal. After considering reviewers' individual comments and using their respective judgment, AARC Board members met in December and selected 48 for further consideration.

The next step started with the application form for the full proposal. The application asked the applicants to address their business goals, the technical aspects of the project and the potential impacts. For example, under the business plan, we asked for a description of the organizations involved and a discussion of their management team and the equipment and facilities required. In addition, we were looking for a well-reasoned analysis of the market dimensions—identification of the customers, the expected market share, trends, competitive advantage and position, pricing strategy, reaction of the competition, and the policy and regulatory environment. We also wanted a four-year revenue and expense statement.

On the technical side, we requested a full description of how agricultural or forestry products would be used, as well as information on the basic chemistry, biology and/or engineering involved. We wanted a discussion of key factors—types of processes, catalysts, chemical reactions, materials and energy balance and pathways. We were also looking for a detailed assessment of the facilities and equipment required for the project. Additionally, we were looking for any major technical hindrances to the project and what steps were taken to address them. We also required a discussion of the product testing involved, as well as a discussion of the necessary governmental approvals, if any, that would be required.

With respect to potential impacts, we had a number of questions we wanted addressed. Was the product a high value–low volume one, or a low value–high volume one? What were the environmental consequences? This included both positive and negative effects during production and process phases, as well as disposal. What were the resource conservation effects? This included the replacement of non-renewables and imports, crop diversification, water supply and quality, soil erosion and use of existing, co-product or waste materials. We also wanted to know if the successful project would impact the cost of Federal crop subsidies or other agricultural assistance programs. Finally, we asked the most significant question of all: Is this project economically viable and how does it benefit the Nation's taxpayers to justify public support?

The full proposals were submitted in February of this year. In total, the 48 proposals requested $30 million in funding. The AARC Center has about $10 million to provide for projects this year. The Board rank-ordered the proposals and is currently negotiating with the top 22 for final funding. At least one Board member and staff person made a site visit to each major project location. The purpose of these visits was to ensure that what was presented on paper actually existed on the ground, and to correct any deficiencies the individual reviewers or Board members saw in the proposals.

DESCRIPTION OF SELECTED PROJECTS

The 22 projects selected for final negotiations by the Board involve 14 different plant and animal materials. They include animal fat, kenaf, waste paper, corn starch, soy meal and oil, industrial rapeseed or crambe, wheat, lesquerella, hesperaloe, grass straw and lodgepole pine. Products being derived from these renewable materials include: composite building material that looks like polished granite; pulp; automotive windshield washer fluid using ethanol; biodiesel; grass mats; degradable polymers for food packaging, personal care items and medical products; biodegradable lubricants, and a concrete form release agent. These products are environmentally friendly and create demand for biodiversity on the farm.

Testifying at today's hearing are representatives from projects we are currently negotiating with to finalize a partnership arrangement. In addition, I want to expand on a few others that look promising.

One is with the Aquinas Technologies Group from St. Louis, Missouri. This small firm currently sells a standard petroleum-based windshield washer fluid. Working with the National Corn Growers Association and Goodwill Industries—who operate their bottling operations—Aquinas plans to begin national distribution of washer fluid made from ethanol, thus producing a new product which is domestically produced, environmentally friendly and safer (Windshield washer now available on the market can cause blindness or even be lethal.) The total domestic market of windshield washer is 120 million gallons—which if derived from corn would amount to 24 million bushels of corn annually.

Another example is with Midwest Grain Products from Atchison, Kansas. This company is a successful agribusiness that processes and markets beverage spirits, industrial alcohol, distill grain feeds, wheat gluten and wheat starch. They see an opportunity to develop and market wheat gluten-based plastic substitutes that are more stable and water resistant than the starch-based materials currently finding their way into the market. A whole new product line is possible and includes: 1) blown or coated films; 2) plates, trays and egg cartons; 3) molded plastics; and 4) packaging shapes. A specific application discussed was coating for cardboard boxes that transport fruits and vegetables.

CREATION OF THE REGIONAL CENTERS

Based on my experience with other USDA programs, e.g. the Sustainable Agriculture and Aquaculture programs, having regional administrative centers saves program dollars—especially when the host institutions must share the costs of operating the center—as required in the AARC Center legislation. When competitive programs are run from Washington, DC, costs are higher for the following reasons: 1) business and panel review members must come to Washington—a high-cost area—at program expense; 2) program support is more expensive—because there is more competition for office space and qualified people in the Washington, DC area than most other parts of the country; and 3) opportunity for more direct interaction with proposal generation and implementation, employing people from lower cost areas yet having direct grass-roots relationships.

Considerable interest exists for hosting a regional center. The regional center's primary responsibilities are to:

- be the grassroots "eyes, ears and mouth" for the AARC Center
- establish a network of processors, marketers, producers, scientists, and financiers to identify opportunities and barriers
- serve as "circuit riders" to form project partnerships and monitor project process
- recommend the best opportunities to commercialize new nonfood, nonfeed products that will contribute to economic growth in the rural areas of the region
- after going through a competitive review process—as designed by the AARC Center Board—make recommendations concerning regional projects that should be funded.

Decisions on where regional centers will be located will be based on the following criteria:

- ability to fully share the administrative costs of operating the regional center
- qualifications to carry out the regional center activities
- geographic distribution—including climatic and economic conditions
- enthusiasm, desire, and creativity demonstrated in championing the cause.

On December 23, 1992, the Board's request for proposals to host regional centers was published in the Federal Register. The Center received 14 proposals by the due date of February 19th. On May 19th, the Board will meet here in Washington. We anticipate that one of the results of that meeting will be the announcement of the location of the *first two regional centers*. In addition, we expect the Board may announce the potential geographical areas for placement of other centers.

THE UNIQUENESS OF THE AARC CENTER

Although established within the USDA, the activities of the AARC Center are distinctly different from the activities of other USDA organizations also engaged with new crops and alternative uses, most notably the Agricultural Research Service (ARS) the Cooperative State Research Service (CSRS), and the Forest Service (FS). Unlike ARS, CSRS, and FS which concentrate primarily on research, the AARC Center's main focus is on closing the gap between promising research results and commercialization. Rather than duplicating the work of ARS, CSRS, and FS, the Center's role complements the work of researchers in other agencies, by providing a vehicle for getting their advances to the market more rapidly. Indeed, the complementary nature of the AARC Center's support can be seen in the number of requests it received to support projects that drew on research work initially funded by ARS, CSRS, and FS. However, the projects the AARC Center is funding also draw on research conducted by private firms and by foreign countries. The focus is on commercializing value-added products that create economic activities and jobs in rural America.

ARS enters into a CRADA only when the research objective is commensurate with the agency's mission. The AARC Center is also different from the various technology transfer programs established between academia and the business world. The Center for Advanced Technology Development (CATD) at Iowa State University is a good example of a successful program helping to transfer technology from the university to industry. Again, however, we differ from CATD in that we are not approaching the issue from the technology development side. We want to see a proposal when the players are at the pre-commercialization stage.

Put more succinctly, the AARC Center's signals come from the demand side, i.e. working in partnership with a private company and developing promising technologies **that already have a clearly identified market.** That is distinctly different from the work of other USDA and university organizations that are involved in the earlier stages of the process, where they are conducting research to identify potential technologies—which may or may not have any commercial value.

Finally, the AARC Center policy and decisions are made by a Board of Directors with vast business, management, manufacturing, and marketing experience. Often individuals from public entities have only a strong technical background. On average over the past year, the AARC Center Board members have devoted over 25 days of their valuable time to the Center. The Board envisions the AARC Center as an excellent and innovative method for the Government to conduct business. The Board is enthusiastic in "making it happen."

CONCLUDING REMARKS

I am very confident that the AARC Center will have a bright and productive future. Our present efforts to use agriculture as a source of industrial products traces it roots to the so-called "Chemurgic Movement," begun in the 1930s. Championed in those days by such men as Wheeler McMillen, Thomas Edison and Henry Ford, the early days of the movement resulted in the establishment of the four ARS regional research laboratories. A number of factors have come together in our present time, however, to move the industrial use of agricultural products beyond the research stage and into a viable business venture. These include:

- more efficient technologies for processing and manufacturing, i.e. biotechnology, continuous fermentation and new chemical catalytic processes
- environmental and regulatory requirements for clean air and water, landfill alternatives, disposability and renewability
- availability of skilled labor and resources in rural America
- increased pressure to reduce agricultural subsidies.

I believe the AARC Center can live up to its motto of "make it happen" and turn market potential into market reality.

Mr. Chairman, this concludes my comments. I will be glad to respond to questions you or other members may have.

Senator **Daschle**. Thank you very much, Dr. O'Connell, for an excellent statement and for an equally impressive demonstration. [Laughter.]

Mr. **O'Connell**. Well, this was water before I did this, and I believe I showed this and this is made from crambe and rapeseed, it can be grown in the great State of Iowa or even South or North Dakota, even Minnesota.

But you can put this in water and it will readily distribute itself as an emulsifier and other things and it will break down much quicker than petroleum-based oil, so that in a marine or forest environment, it is the sort of thing, quite frankly, that I think will be required in the not too distant future. In this particular case, this is cutting oil, but there are also products for the marine and forest environment. So it really is an exciting kind of project.

Senator **Daschle**. Just out of curiosity, to what extent would we have the ability within a short period of time to produce volumes of that adequate to meet a commercial market?

Mr. **O'Connell**. Joe, where is this at right now?

Mr. **Roetheli**. I am Joe Roetheli, Deputy Director. That product is being produced by a small company in Seattle, Washington. They will be processing in a plant in Skogie, Illinois, hopefully by late summer, if we can get everything in place. I just talked to the people in Skogie yesterday, and that could be on the market by Christmas time of this year easily.

Mr. **O'Connell**. It is one of our projects, by the way.

Senator **Daschle**. I don't want to get into all of this now, but it occurred to me that it would be appropriate at some point for the Government to be the first purchaser of that product.

Mr. **O'Connell**. Absolutely.

Senator **Daschle**. We could set the market, and the Government should be leading the way. It is a perfect opportunity to demonstrate it.

Mr. **O'Connell**. The Forest Service, for example, has been involved in it for many years and——

Senator **Daschle**. And the Coast Guard.

Mr. **O'Connell**. The Coast Guard, exactly. I think that is true with a lot of these products that are domestically produced, where the Government, as you indicated, can lead the way and show that this can be something that is beneficial beyond just the cost of the original product, and I agree with you totally.

Senator **Daschle**. Again, Dr. O'Connell, thank you.

Let me call on Senator Harkin. He just arrived and has been extraordinarily interested in this and had a lot to do with the creation of AARC.

Senator Harkin.

Senator **Harkin**. Thank you very much.

I want to thank you, Senator Daschle, for holding this very important hearing. I know you have been a strong supporter of this program.

I was just saying to Senator Conrad that it is nice to see legislation that actually gets through and something comes of it, you know. [Laughter.]

I do want to thank my colleague Senator Conrad for helping put this legislation together and getting it enacted in the 1990 farm bill. We had some funding for it, as you know, in 1992 and 1993, and we have got $20 million requested in the President's budget for next year, and I hope to at least get that, and I would hope it would be a lot more.

So I again want to thank all of you and the Board members and Dr. O'Connell, for what you have done in taking the leadership on this effort. I think this is the way we have to go.

As I said before, it didn't make much sense to me that we were spending maybe 80 to 90 percent of the research money in the Department of Agriculture to figure out how to grow more, and at the same time we turn around and we pay farmers to take land out of production so they won't grow so much. I thought we needed to be spending some research money on finding new products for what they grow, new nonfeed, nonfood products or even finding new types of crops to grow.

I really think, with biotechnology and genetic engineering, that we really can have a whole new era, I call it a new golden age of agriculture, coming in the next 20 to 30 years, where again we will use our farms not just for food and feed, but oils, for pharmaceuticals and for all kinds of things.

You showed me some products earlier on that were made out of soybeans, I believe. Well, I guess you have got some there, the plastics that——

Mr. O'CONNELL. Yes, Mike will be testifying here about them and I am sure he will be glad to share.

Senator HARKIN. Of course, I used to carry around with me a picture of Henry Ford and the soybean car he had.

Mr. O'CONNELL. Right.

Senator HARKIN. Again, but for World War II, that might have been a reality a long time ago, and I think we are now coming back to that again. So I think this is a way that farmers will be able to make money and will be able to revitalize and reinvigorate the rural economy in America with this.

Mr. O'CONNELL. I indicated to the Chairman and Senator Conrad before you came in, there is a new book that just came out, "The Carbohydrate Economy," and it gives a little bit of a history, but an indication that actually this is happening, beginning to happen. Plant-derived materials are beginning to come back in a meaningful way. I didn't even realize how much. So they project that the sort of thing, the point that you are making, is beginning to happen and we need to speed that up.

Mr. Chairman, there is just one other point I wanted to make, I meant to make it in my comments, and some people may not be aware of this. In the President's budget for 1994, it is $20 million in requested funds. I want to make sure that was on the record.

Senator HARKIN. Good.

Senator DASCHLE. Again, Dr. O'Connell, I know we will have a lot more to talk about as we complete the panel.

Let me now welcome Mr. Lee Reeve, who, as I said earlier, is the producer representative on the AARC Board.

Mr. Reeve.

STATEMENT OF LEE M. REEVE, BOARD MEMBER, ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION BOARD, U.S. DEPARTMENT OF AGRICULTURE, GARDEN CITY, KS

Mr. REEVE. Thank you, Mr. Chairman and members of the committee.

As a member of the Alternative Agricultural Research and Commercialization Board, I thank you for the opportunity to update you on the activities of the AARC Center.

It is increasingly clear that the AARC Center's concept is right for the times. There is a widening gap between rural America and rural development. With the tremendous productive capacity of U.S. agriculture, new uses for productive capacity need to be found. The equation is simple: We have more productive capacity than we have traditional markets for that capacity. This dilemma can be an opportunity with the development of such industrial products as plastic substitutes, oxygenated fuels, lubricants, coatings and annual fiber crops that can compete with imported newsprint. We need uses for 65 million acres of land farmers have idled at a cost of roughly $10 to $20 billion annually to American taxpayers. The AARC Center is seeking processes and technologies to use perennial and sustainable crops from such land, thereby providing farmers, like myself, expanded real markets.

I think the AARC Center has made remarkable progress in the first year of operation. We at the AARC Center have gone from a standing start, to where we are funding our first projects. This has been a learning process for all of us. After going through the steps, opportunities to streamline the process appear.

The Board, as well as the staff, have individually invested a lot of time bringing AARC to this point. This commitment of the Board of Directors is exemplified by the fact that the average Board member has devoted over 25 days to the AARC Center over the past year. We all believe in the concept of the AARC Center. We, the Board, envision vast opportunity and are dedicated to transforming that opportunity into reality for American farmers and American taxpayers. The staff's dedication should also be noted. We have a small staff that includes the Director, Paul O'Connell, plus a Deputy Director, one other technical person, an administrative assistant and two clerical people. The Center received 407 pre-proposals, most of them arriving just a few days of the deadline of October 30th. By December 5th, just five weeks later, the Board received review comments from three external reviewers, plus the staff, on the proposals with each pre-proposal containing a summary of the numerical review rating. They accomplished this while carrying out the normal business of the office.

The Board uses the reviews and its own judgment in selecting pre-proposals for further consideration. We received 11 applications related to producing ethanol and other chemicals from lignocellulose, such as grasses, corn stalks, straw, cotton gin trash, and trees. We also have six applications on biodiesel production. The

Board decided to meet with each of these applicants to obtain more detail. When this was completed, the Board had selected 48 applicants to submit full proposals. From these, the Board selected 22 for final negotiations. Paul O'Connell will provide more details on the process we used. The Board and staff are currently negotiating final arrangements.

I believe the addition of the regional centers are critical to maintaining the momentum and fulfilling the ambitious goals set out in our strategic plan. It is heartening to see the interest and the quality of the regional center proposals. We are in the process of deliberation on these centers. This is truly a business where you need to be out with the people. I believe the regional centers will be especially important for small projects that need someone to help "shepherd" their projects through the process.

Our strategic plan, which is in reality born out of the law itself, as well as the input of over 200 presenters at our public hearings, has been very beneficial in keeping focused on evaluating proposals. This document clearly states what we are about and how we plan to measure results. It is made available to all those who are interested. People can quickly see if they can do business with us.

We all recognize that our strategic plan, as well as the AARC Center itself, may change over time. That is why we call it all "A Living Document."

The bottom line on any proposal is that the project must make money and, more specifically, the people that present the project have to convince us that they can make it profitable.

The challenge today is not a shortage of promising ways to convert renewable materials into useful products, but the lack of support for bringing them far enough along to attract private investment.

Let me read a list of thoughts that make up the spirit of the AARC Center, as we see it: Identifying viable market needs, forming private/public partnerships to bring new products or processes to the market; having the private sector take the lead; cost sharing, not just grants; risks are shared, but rewards are also shared; identifying champions, being a champion in the industrial area; facilitate and broker exchange of information about products; run the AARC Center like a business; maintain environmental awareness; easy to deal with; and, overall, make it happen.

What I have briefly discussed is the means to the end, the end being the reversal of the deterioration of rural America. I can assure you that we at the AARC Center are dedicated to achieving this end.

From a personal point, I am the producer representative on the AARC Center, and we have an integrated operation in western Kansas. We produce grain crops, ethanol, cattle, fish, and we have a couple thousand visitors a year, and one overriding statement that is made time after time is, you know, you guys do this, why don't more people do this? That is kind of puzzling. I mean we are not geniuses. We just do these things. With the AARC Center, I think we have a vehicle to make a lot of those things come into reality.

I would be glad to answer any questions.

Senator **Daschle**. Thank you very much, Mr. Reeve.

I am anxious to get out there sometime. I want to see it, as well. I have heard much about it and, I must tell you, I have the same question. Why don't more producers have integrated operations? You may not be a genius, but I do appreciate your innovation and the leadership you have shown in this whole area. It is remarkable, and you are the ideal person to be serving as our producer representative.

Mr. REEVE. Thank you very much. Of course, you guys are all welcome.

Senator DASCHLE. Do you serve a meal afterwards or something? [Laughter.]

Mr. REEVE. We used to serve fish to these groups, and it got to the point where it was cutting into our profit. [Laughter.]

Senator DASCHLE. Dr. Jolliff?

STATEMENT OF GARY JOLLIFF, PROFESSOR OF CROP SCIENCE, OREGON STATE UNIVERSITY, CORVALLIS, OR

Mr. JOLLIFF. Thank you, Mr. Chairman and distinguished members of the subcommittee.

My name is Gary Jolliff, and I am professor of crop science at Oregon State University, and a member of the Board of Directors of CAST, which is the acronym for the Council for Agricultural Science and Technology. It is both an honor and a pleasure to participate in this hearing; and I must say I am delighted to be here. Oregon State University and CAST shared in support of my trip to testify today. However, my remarks are a personal perspective as a scientist working in the area of new crops and do not imply an official position of any organization with which I am affiliated.

Approximately nine years ago, I served on the CAST Task Force on New Crops, which reported to the Joint Economic Committee of Congress. Subsequently, I have had regular involvement in activities related to the Alternative Agricultural Research and Commercialization Center development efforts. References to those activities are in the materials I prepared for the subcommittee record.

Mr. Chairman, with your permission, I would like to submit a written testimony, plus 3 exhibits, for the record. In the final stages of preparing these materials, I had a technical problem, so I will have to submit a revised copy to the clerk.

Senator DASCHLE. Without objection, all will be made a part of the record.

[The prepared statement and exhibits follow:]

PREPARED STATEMENT OF GARY D. JOLLIFF, PROFESSOR OF CROP SCIENCE, OREGON STATE UNIVERSITY; AND MEMBER, BOARD OF DIRECTORS, COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY

I. ABSTRACT

Based on printed information provided to me for evaluation, it appears that the Board of Directors of the Alternative Agricultural Research and Commercialization (AARC) Center is following the letter of the AARC Act of 1990, and doing so expeditiously. "The Strategic Plan: A Living Document" looks like a good tool for communication. It appears that the many good ideas are in accord with the letter of the AARC Act of 1990 (The Act).

The AARC Center is an institutional innovation. Rightly, the objective of the AARC Center design is to facilitate doing business differently from existing organizations.

Similarly, it seems there is now a critical need for innovation in developing an accountability system to be constructive and to assure that the AARC Center Board of Director activities also meet the letter (Section 1659.c.) and spirit of the AARC Act of 1990 over the long term.

It is recommended that a system of accountability for the AARC Center Board of Directors be developed as soon as possible to avoid giving the impression that something is being done wrong within the AARC Center system which needs correction. Careful selection of professional counsel is recommended to bring an appropriate balance of expertise in guiding the development of an accountability mechanism. It is recommended that *the decision making process used by the AARC Center Board of Directors, including deliberations on policy, should include at least one rural sociologist and one ethicist having expertise relative to the family farm and rural America.* A highly effective and helpful accountability system should aid in attracting the very best talent to the AARC Center Board and staff in the future.

The AARC Center Board of Directors may have part of this system in place. If it does, the mechanism needs to be specified in writing and provided to the subcommittee and others who have oversight responsibilities.

Several references are listed below in order of importance of topics rather than by authors, titles or years. Each reference has an accompanying quote or concept that substantiates and dramatizes the reason for giving priority to the careful development of an accountability system. The call from society-at-large for accountability in Government and industry is widespread and justified. The AARC Center can be a national leader in this arena and turn a challenge into an opportunity. Like other administrative bodies overseeing agricultural affairs, the AARC Center Board of Directors needs to solicit and value the inputs from, and assessments by, ethicists and rural sociologists. It has been too easy, in the paradigms of recent decades, for the farmers to be "left out in the cold" after "producing wood for everybody else's fires." The concept of the AARC Center is too valuable and has been too long in coming to allow any part of its success to be left, unnecessarily, to chance. The AARC Center needs to have earned, within 15–20 years, the strong support of farmers.

References with Quotations or Concepts for Abstract

Bella, D.A. 1987. Organizations and systematic distortion of information. *Journal of Professional Issues in Engineering.* 113:360–370. "* * * modern organizational systems, by their very nature, distort information to meet organizational needs * * * [distortions] do not [necessarily; or by nature] require unethical behavior on the part of individual persons * * * [and, distortions are] often * * * sustained by basically good people."

Allen, C. Eugene. Vice-President, Institute of Agriculture, Forestry and Home Economics, University of Minnesota, St. Paul. *Addressing Change in Land-Grant University Programs.* Presented April 3, 1992, at a meeting of the Board on Agriculture with representatives of the professional scientific societies. National Academy of Sciences, Beckman Center, Irvine, CA. "It seems that many of the criticisms of public higher education in the U.S. can be boiled down to real or perceived issues that involve accountability * * * we need to ask the question, 'When is it appropriate for us to help shape change vs. just accepting that change will shape our programs and institutions?' "

Krueger, William C. 1992. Building consensus for rangeland uses. Rangelands 14(1):38–41. "Each group analyzes different, sometimes selected, information in a different logical framework and naturally, then, defines the truth differently."

Ruttan, V. W. 1990. Challenges to Agricultural Research in the 21st Century. Paper given at Symposium on Technology and Economics, National Academy of Engineering, Washington, DC, April 4, 1990. "Thus, in the populist view, agricultural research was [is] regarded as a powerful instrument of technical and social change that has been captured by organized agribusiness and has misdirected its energies against the people and the institutions that it was designed to serve."

Ruttan, V. W. 1992. Sustainable growth in agricultural production: Into the 21st Century. *Choices,* Third Quarter:32–37. "Develop incentives for behavior compatible with social objectives for management of resources. Initiate * * * research on the design of institutions capable of implementing incentive compatible resource management policies and programs * * * The challenge is to design institutions whereby people and organizations find it advantageous to act in ways that help achieve overall goals of society * * *."

Fuglie, K., and V. W. Ruttan. 1989. Value of external reviews of research at the International Agricultural Research Centers. *Agricultural Economics,* 3:365–380. "Disciplinary and project activity should be reviewed by individuals who are at

the leading edges of their field of science or technology development. *They usually will not be the same individuals who are best able to evaluate long-range strategies and priorities, i.e., to evaluate relevance rather than competence."*

Browne, W. P., et al. 1992. Sacred Cows and Hot Potatoes: Agrarian Myths in Agricultural Policy. Westview Press. "The strength of this book is that it defines American agriculture as it really is, not as it exists in popular mythology, then proceeds to show the incongruity between government programs and those realities"—Rudy Boschwitz, Former U.S. Senator. "First, policymakers and the public are held captives of the agrarian past through myths [Myth: a notion based more on tradition or convenience than on fact.] that have evolved over time * * * These myths rest on a nearly blind faith that agricultural interests will both want and do the right things * * * We ask only that agricultural interests pick up the mantle of proof. If they want programs to continue, they should demonstrate beyond some reasonable doubt that the public well-being is served."

Gardner, J. W. 1981. Self-Renewal: The Individual and the Innovative Society. W. W. Norton & Co. "* * * The book deals with the institutional arrangements and processes that affect renewal * * * there cannot be long-continued renewal without liberty * * * liberty requires limiting and disciplining power * * * two strategies [for limiting power] have emerged as superior to all others. One is the creation of institutional arrangements and laws designed to place constraints on power. The other strategy is to disperse power; * * * Dispersing power is an endless task; it never stays dispersed for long * * *. the abuse of power remains an ever-present possibility." "* * * There is today a new awareness of the nonprofit segment of the private sector * * *" "An idea that is controversial, unpopular or strange has little chance in either the commercial or the political marketplace. But in the nonprofit sector it may very well find the few followers necessary to nurse it to maturity * * *. And it is from just such individuals and groups that one may expect emergence of the ideas that will dominate our society and our world a century hence. Generally speaking, great social changes begin with few supporters."

American Society of Agronomy. ASA, CSSA offering ethics statements. Agronomy News, January 1993, p. 8. "* * * Statement of Ethics, American Society of Agronomy * * * Demonstrate social responsibility in scientific and professional practice, by considering whom their scientific and professional activities benefit, and whom they neglect * * *."

Heichel, G. H. [Past-President of the Crop Science Society of America]. A Farewell to "Reluctant Revolutionaries." Agronomy News. April, 1993. page 9. "An 'ethic' is a principle or standard of what is good, right, or moral conduct, behavior intention, or social action in relation to others * * * In my opinion, the wall of silence on ethical matters behind which crop scientists and agronomists had hunkered for so many years crumbled to ruin on 1 and 2 Nov. 1992 * * *. The responsibility [to demonstrate social responsibility] is not more obvious than in the imperative to consider the external costs flowing from the pursuit of the productive agriculture that society does not view or value as benefits: environmental problems, social inequities, geopolitical inequities, fraud and misrepresentation, conspicuous mistakes. Why have external costs been omitted from the calculation of the benefits of "production" and "productivity?" * * * I urge you to affirm this [Crop Science Society of America] statement of ethics and to implement it * * * and exemplify its principles in mentoring * * * students * * * citizens and public policymakers."

Keeney, Dennis. Changing Paradigms and the American Society of Agronomy. Agronomy News, Feb. 1992, p. 3. "* * * What is agronomy's role in society? * * * Much of the discussion is based on the role of disciplines in science and education * * * Complaints of reductionism abound. The public feels science has turned inward, being mostly concerned about continued propagation of the species and less on returning value to the public that supports its activities * * * ASA must launch a new strategic planning exercise to chart its future * * *."

Barker, Joel. 1990. The Business of Paradigms. ChartHouse International Learning Corporation. Burnsville, MN. 1-800-328-3789. Concept: Too strong a belief in a paradigm can create paradigm paralysis, a terminal disease of certainty, which blocks progress.

Barker, Joel. 1992. The Power of Vision. ChartHouse International Learning Corporation. Burnsville, MN. 1-800-328-3789. Concept: Effective leaders empower people to real goals by the manner in which they develop a "vision community."

Barker, Joel. 1993. Paradigm Pioneers. ChartHouse International Learning Corporation. Burnsville, MN. 1-800-328-3789. Concept: A special kind of leader is needed to facilitate paradigm shifts * * * this [paradigm] concept reinforces the power and need for "cross-over" discussions between different fields—especially between the technical and nontechnical.

Congress of the United States; Office of Technology Assessment. Page 1. In Agricultural Research and Technology Transfer Policies for the 1990's; OTA-F-448, March 1990; A Special Report of OTA's Assessment on Emerging Agricultural Technology: Issues for the 1990's. 50 Pages. "A new agenda is emerging for American agriculture in the 1990's, and there are serious questions as to whether the current agricultural research and extension system can respond effectively."

National Academy of Sciences. Enhancing the Future of the Land Grant System. A Dialogue on Environment and Society. Spring Symposium, Board on Agriculture and the Professional Scientific Societies, National Academy of Sciences Beckman Center, Irvine, California, April 3-4, 1992. "Many observers have noted that the land grant system must renew its social contract. The system must respond to a changing student body, a changing set of critical problems and opportunities, a changing clientele, and changing technology for information delivery. Old structures and cultural norms no longer fully meet the demands of these new realities."

Congress of the United States; Office of Technology Assessment. Pages 410-411. In: A New Technological Era for American Agriculture Research and Technology Transfer Policies for the 1990's. OAT-F-474. August 1992. 452 Pages . "Over time, the sense of institutional mission [of the land-grant universities] has declined as research has become more basic and more focused on increasing disciplinary knowledge than on solving the problems of society * * *. External critics focus primarily on the heavy research emphasis on agricultural productivity and the lack of research devoted to nutrition, rural problems, and environmental concerns * * *. * * * the public sector agricultural research system is being challenged from many directions. Whether the system can be revitalized and renew its historic commitment to solve the problems of society, or whether it becomes isolated and loses its credibility with the public remains to be seen. The decade of the 1990's will be a period of significant change within the agricultural research system * * * increased activism of a wider range of constituents is indeed changing the climate in which the land- grant system conducts research."

Council for Agricultural Science and Technology (CAST). Ecological Impacts—of Federal Conservation and Cropland Reduction Programs. CAST Report No. 117. September 1990. 28 Pages. "Overproduction in agriculture first became a major problem in the United States in the years following World War I. * * * The primary purposes of these programs [Acreage Reduction] have been to reduce the overproduction of agricultural commodities and to elevate the depressed prices of agricultural products and declining farm income * * * Farmers are being asked to diversify their ecosystems without an adequate research base to provide an understanding of the potential beneficial or detrimental consequences * * * The year 1985 was important in agricultural policy, because a new coalition of agriculturalists and environmentalists fashioned a farm bill that continued the recent pattern of large economic transfers to farmers, but imposed unprecedented requirements and incentives for conservation."

Water Quality, Agriculture's Role. Council for Agricultural Science and Technology. Report 120, Dec. 1992. "* * * The time is right for everyone to work toward a new agricultural ethic that will achieve both agricultural and environmental quality goals of a safe affordable food supply, a prosperous farm sector, and a stable, productive ecosystem."

II. INTRODUCTION

Mr. Chairman, and distinguished members of the subcommittee, my name is Gary Jolliff. It is both an honor and a pleasure to participate in this hearing.

Affiliations

I am a Professor of Crop Science at Oregon State University and Leader of the New-Crops Research Project of the Oregon Agricultural Experiment Station. I represent the American Society of Agronomy on the Board of Directors of the Council for Agricultural Science and Technology (CAST). In March of 1992 the CAST Board of Directors asked me to serve as the CAST liaison to the AARC Board of Directors. Oregon State University and CAST shared support of my trip to testify today. However, the presentation represents my own perspective and does not necessarily reflect any official position of the organizations with which I am affiliated.

Personal Background Related to AARC

Approximately nine years ago I served on the CAST Task Force on New Crops which reported to the Joint Economic Committee of Congress. Subsequently I have had almost continuous involvement in activities related to the Alternative Agricultural Research and Commercialization (AARC) Center development effort. My experience with, and strong support and rationale for, your efforts can be traced in the following list of references:

National Task Forces

Black, C. A. (ed.), and others, including G. D. Jolliff. 1984. Development of new crops: needs, procedures, strategies and options. Council for Agricultural Science and Technology (CAST). Report No. 102. 30 pp. CAST. Iowa State University, Ames, Iowa.

Sampson, R. L., G. D. Jolliff, and others. 1987. New Farm and Forest Products: Responses to the Challenges and Opportunities Facing American Agriculture. A Report from the New Farm and Forest Products Task Force to The Secretary, U.S. Department of Agriculture, Washington, DC. 55 pp.

Testimonies

Jolliff, G. D. 1987. New Farm and Forest Products: Responses to the Challenges and Opportunities Facing American Agriculture. pp. 94–99 and 221–329. In: New Uses for Farm and Forest Products. U.S. Senate Hearing 100–471, June 26, 1987. Testimony before the United States Senate Committee on Agriculture, Subcommittee on Agricultural Research and General Legislation. Wash., DC. 344 pp.

Jolliff, G. D. 1988. Testimony on S. 2413, The Agricultural Research Commercialization Act of 1988. pp 58–131 and 141–143. In: The Agricultural Research and Commercialization Act of 1988. United States Senate Hearing 100–832, June 6, 1988. 174 pp.

Jolliff, G. D. 1990. Testimony on funding research, development, and commercialization of new crops. pp. 284–322 and 331–341. In: Preparation for the 1990 Farm Bill—Part IV; State of Agricultural Research; U.S. Senate Hearing 101–259, Part IV. July 27, 1989. 777 pp.

Jolliff, G. D. 1990. Testimony on HR 47, HR 1505, and HR 2691 regarding new-crop development. pp. 521–523 and 557–576. In: Formulation of the 1990 Farm Bill (Research, Teaching, and Extension Programs). Research, Development, and Commercialization of New Products and Crops. U.S. House of Representatives Hearings. Serial No. 101–30; Part 11. July 19, 1989; Feb. 6, Mar. 7 and 13, 1990. 682 pp.

Jolliff, G. D. 1992. Invited Testimony (Written) on Commercializing New Crops. Before the Alternative Agriculture Research and Commercialization (AARC) Board, Office of the Secretary, United States Department of Agriculture. Public Hearing. Northwest Region. Portland, OR. May 27, 1992. 6 pp. plus 11 exhibits. [Invited as member of New Farm and Forest Products Task Force, and Board member of Council for Agricultural Science and Technology (CAST)].

Jolliff, G. D. 1992. Invited Testimony (Summary of Oral) on Commercializing New Crops. Before the Alternative Agriculture Research and Commercialization (AARC) Board, Office of the Secretary, United States Department of Agriculture. Public Hearing. Northwest Region. Portland, OR. May 27, 1992. 1 p. [Invited as member of New Farm and Forest Products Task Force, and Board member of Council for Agricultural Science and Technology (CAST)].

Jolliff, G. D. 1992. Testimony (Summary of Oral) on Commercializing Meadowfoam. Before the Alternative Agriculture Research and Commercialization (AARC) Board, Office of the Secretary, United States Department of Agriculture. Public Hearing. Northwest Region. Portland, OR. May 27, 1992. 1 page plus 8 exhibits.

Documents of past congressional hearings which contain the above testimonies are available in all States, at regional depositories of Federal Government documents, and probably at most land-grant university libraries.

Work Experience

During the past 15 years I have led a research team at Oregon State University working on the domestication and commercialization of a wildflower called "meadowfoam." This plant is native only to the Pacific Coast region of North America. It is a new oilseed crop with more than 500 acres under cultivation this year in the Willamette Valley of Oregon. This project represents a rare, if not unique, combination of developments. First, it is a native wild plant domesticated in this country. Second, a Growers Association was formed to meet the first commercial-scale sale of oil. Third, the first sale was transacted in a high-value Japanese market.

Mr. Chairman, much of what I have written in this testimony and the above references is the result of first-hand experiences, or fairly direct observations. I trust that my input will be of use to you and to the AARC Center Board of Directors.

III. THANKS AND CONGRATULATIONS

If you will permit me to take some liberty in the record, I would like to express appreciation to you, your many colleagues, and especially Senator Conrad, for the untiring efforts in getting the AARC Act of 1990 passed, the appropriations in place, the AARC Center created, and the Board appointed. The AARC Center Board of Directors, Center Director, and Center Staff deserve much credit for getting the Center functioning, and getting project pre-proposals and regional center proposals requested, screened, developed, and into negotiations.

Decades of Efforts

You may recall from the documentation in my testimonies cited above that many previous attempts in Congress to create an institutional innovation, with goals like the AARC Center, ended in failure. In the 1930's Wheeler McMillen, with the assistance of Henry Ford and the support of Henry Hoover and Thomas A. Edison, organized the Farm Chemurgic Council (and published the Chemurgic Digest) to stimulate new thinking to expand the industrial use of U.S. farm products. Therefore, I believe the AARC Act of 1990 represents, for you and your colleagues, a victory through statesmanship.

A Paradigm Shift

Mr. Chairman, I would say that, in creating the AARC Center, you and your colleagues have created a new paradigm (Barker, 1990) or a new set of rules for doing business in this area of new product research, development, and commercialization. This is exciting, and very timely.

Opportunity to Trigger a Megatrend

According to Joel Barker, a change like this could trigger a "megatrend." I believe America needs a megatrend toward the objectives and spirit of the AARC Center. The current buzzword in Washington is "change." The AARC Act of 1990 provides excellent opportunities to forge change and develop a paradigm pliancy for the AARC Center Board of Directors itself. The AARC Center Board should have the opportunity to exercise all the innovation they can muster from all sources.

The Power of Vision

The power of vision and paradigm pioneering should provide great opportunities for the AARC Center to help American agriculture ensure future economic prosperity for farmers and rural America while contributing to the financial well-being of all citizens. That is why, in my opinion, there is an urgency to develop a positive, and constructive accountability system to help assure the success of the AARC Center. This is discussed later in greater detail. But, Mr. Chairman, the potential power of vision for development of this accountability system probably rests presently with this subcommittee.

IV. THE "TRILLION DOLLAR" OPPORTUNITY

And finally, in the congratulatory vein, I have one number to offer today which may help dramatize the tremendous opportunity which lies before the AARC Center. It is a dollar value estimate which I made. I recognize the risk in making this estimate, because broad agreement has probably never been reached on how to make such calculations. However, my purpose is to draw attention to the issue rather than have a perfect number. It reflects the magnitude of the opportunity I believe exists for the AARC Center to encourage, facilitate, promote, support, and lead in the growth of the contribution of the agricultural sector to the national wealth.

Excess Production Capacity

The estimate deals with the problem of excess production capacity in American agriculture. What extra wealth might the U.S. have gained if profitable alternative crops had been made available to U.S. farmers in 1978–1992 to provide an average profit of $159 per acre (or even $80/acre)? One could assume that, producing alternative crops, rather than Government-program crops on all excess acres would save the Government money. Moreover, the market price of the program crops would be higher because they generate no surplus.

This calculation is a symbol of the frustration felt by many American farmers who do not have profitable alternatives to the production of traditional surplus-commodity crops.

The AARC Center can help give family farmers a way out of the economic trap of Government-program crops. My estimate covers the period 1978–1992, which approximately corresponds to the period I have been working on the development of the new crop meadowfoam.

Four component values constitute the estimated total in Table 1. They are: 1) the cost of taking land out of production [farm income support and related costs resulting from low prices and lack of markets (Budget Function 351 plus Certificate Programs)]; 2) the loss of direct income from idled land, 3) the loss of economic activity from the multiplier effect (2.0) by not having profitable crops to grow on the idled land, and 4) interest on item 1 above.

TABLE 1.—TOTAL SET-ASIDE LAND IN UNITED STATES AGRICULTURE AND ASSOCIATED LOSSES OF ECONOMIC WEALTH FOR THE NATION.

See below for further explanation of columns. Numbers were rounded after computations, therefore, values from table will not compute exactly.

Year	Set-aside idled land (mil. acres)	In billions of dollars				
		Lost profit from idled land	Lost multiplier in economy	Farm income support expenses (FIS)	Interest on FIS cost	Total costs
78	18.3	3	6	10	8	26
79	13.0	2	4	10	7	23
80	0.0	0	0	7	5	12
81	0.0	0	0	10	6	16
82	11.1	2	4	13	7	25
83	77.8	12	25	24	12	73
84	27.0	4	9	25	11	49
85	30.7	5	10	26	10	51
86	48.1	8	15	33	12	67
87	78.2	12	25	43	13	93
88	77.7	12	25	26	7	70
89	60.8	10	19	17	3	49
90	61.5	10	20	12	2	43
91	65.0	10	21	14	1	46
92	55.2	9	18	19	1	46
Total	624.4	99	199	289	104	691

Column identification and explanation for Table 1.

1. Year.
2. Total U.S. set-aside acres (millions). Source: USDA, ASCS, Deputy Admin. for Policy Analysis, Grain Analysis Div. (Tel. 202–720–7923).
3. Lost profit, i.e. new national wealth (column 2 × $159) from set-aside acreage. Estimated $159 per acre calculated from $50 billion net farm profit (including gov't payments) on 314 million acres.
4. Lost economic activity in Nation resulting from loss in column 3 (col. 3 × 2). Used conservative multiplier of 2.0. (Some suggest a multiplier of 2.75)
5. Federal expenses for farm income support (FIS). This is the sum of Budget Function 351 plus Certificates. Source: USDA Budget Office, S. Dewhurst, Director, personal communication.
6. Interest expense on FIS (column 5). Calculated at 5 percent simple interest.
7. Total of columns 3–6.

$ > 500,000,000,000

My estimate of the total cost to the national economy during 1978–1992 was $691 billion. Reducing the estimated profit potential per acre from $159 to $80 still gives a value of more than a half trillion dollars. If the real value lost (which nobody knows) is only 50 percent of my estimate, the economic opportunity still is certainly worth pursuing. The AARC Center can be a trigger to a megatrend in this arena.

Help Reduce the Federal Deficit

I would expect that President Clinton and Congress are interested in a topic which has an economic impact opportunity potential in this range. Mr. Chairman, the apparent magnitude of this economic opportunity approximates, in the majority of years, the size of the current, almost $50 billion U.S. trade deficit with Japan which has captured so much national attention. I believe that the AARC Center Board has the opportunity to develop its credibility and then capture the national attention and support (as a "vision community") with a new megatrend in agriculture.

The painful experiences with the General Agreement on Tariff and Trade (GATT) negotiations might support the notion that such a megatrend might rapidly spread worldwide. There seems to be a huge excess production capacity globally in agriculture that keeps nations at odds about trade.

I trust that this subcommittee can help its colleagues, the AARC Center Board, and the U.S. agriculture "establishment" establish a vision for investing in the future based on a new paradigm. Agriculture must be more than food. Agriculture must be more than food, feed, and fiber. These stereotypes are evidences of the ancient paradigms which paralyze our vision. Obviously, we must produce food. But it is equally important that farmers make a profit. Rural America must retain some minimum social infrastructure. We need to learn how to use our land resource for sustainable production of wealth, even though it will require going beyond food, feed, and fiber. That is the vision which Wheeler McMillan and Henry Ford tried to kindle in the 1930's. The AARC Center Board now has a chance to lead in developing this vision. I wish them the very best in their efforts.

One Battle Won ... Many More to Come

Mr. Chairman, I encourage you to keep the faith with the AARC Center for the long-haul. The problem of U.S. agriculture's excess production capacity is not subject to a quick-fix solution. It is a long-term problem, developed over decades of neglect. Solutions will require long-term commitments sponsored by people having new paradigms, and facilitated by an institutional structure like you envision for the AARC Center.

V. MY ASSIGNMENT

Mr Chairman, in accord with your request, I have examined the published information provided on the activities of the Alternative Agricultural Research and Commercialization Center Board of Directors, since their appointment, with respect to the AARC Act of 1990 which is Public Law 101-624.

Intent to Provide a Constructive Critique

I trust that my input will aid you in your mandate for oversight of the AARC Center Board of Directors. It is my goal to contribute in any way I can to the success of the letter and the spirit of the act. We will get to the letter of the act in a moment.

The Spirit of the AARC Act of 1990

My interpretation of the spirit of the act is as follows: Mobilize the brainpower of this Nation (and other nations if appropriate) to convert U.S. agriculture's excess production capacity from a Federal budget liability to an asset; and include the family farm and rural America as partners and early benefactors. Change the mindset, and exchange popular mythology (Browne et al., 1992) for reality.

AARC ... A Paradigm Shift ... Inspire More Paradigm Shifts ... (Trigger a Megatrend?)

To illustrate the point, consider the similarity between the U.S. agricultural science, technology, and industrial complex and the U.S. automobile industry for speed and degree of responsiveness to outside pressures for change. In the 1960's and 1970's futurists were suggesting needed changes in the automobile industry. Now history shows us the huge industry was slow to respond. Similar kinds of things have happened to IBM and Sears. Consumers voted with their purchasing power through showroom sales in a free market. Accountability of comparable sensitivity in agriculture is needed. The concept of the AARC Center is a paradigm shift. The AARC Center can help all of the agriculture "establishment" become paradigm pioneers (Barker, 1993), and help improve the sensitivity of agricultural policy to the opportunities for generating renewable wealth for America.

Horizontal Integration and Paradigm Pioneering Promotion

Apparently the AARC Board has already made moves to help establish infrastructure to facilitate horizontal integration of expertise to bridge the commercialization gap using the team approach as practiced in Japan. As Barker (1993) has pointed out, the United States is the world's leading source of new ideas (paradigm shifters), but Japan is the world leader of putting new ideas into commerce (paradigm pioneers). I am confident that the AARC Center Board wants to facilitate paradigm pioneering in U.S. agricultural industries. I trust that the Board is accessing insight about the Japanese expertise in paradigm pioneering.

The AARC Center as a "Learning Organization"

Peter Senge (1990) has stated quite clearly that in today's information age, global economy, and fast moving society, *successful organizations must become "learning organizations"* moving away from having only a single person, or few persons, at the top doing the learning and making the decisions.

It is exciting to see that the AARC Act of 1990 gives the AARC Center Board of Directors the freedom to access virtually all resources—mental, financial, industrial, political, etc.—needed to accomplish the task. This is a monumental opportunity. The effort needs all the help and encouragement the Nation can muster! (I believe the Council for Agricultural Science and Technology would be willing to assist.)

In short, Mr. Chairman, I am excited about the prospects for what the AARC Center might contribute by facilitating the sustainable production of new, annually renewable wealth in the Nation via the family farm.

Strategies and Tactics Against Common Pitfalls

The AARC Center represents an institutional innovation for doing business by a new set of rules. However, like any organization, the AARC Center is subject to oversights and errors. I have mentioned numerous positive aspects of my assessment of the AARC Center, but I also have intentionally tried to bring to bear the information that I perceive as important to a constructive critique of the AARC Center to contribute to its success for America. In the abstract I cited materials related to pitfalls. Additional references and exhibits are provided to emphasize the hazards.

The Total Quality Management (TQM) Model

I would like to envision The AARC Center as a source of new paradigms, as a practitioner of Total Quality Management (TQM), and as a stimulator of paradigm pioneers as partners in moving projects forward. As a "service organization" with the family farm and rural America as its client base, it will be important to emphasize interpersonal skills such as communication, conflict resolution, and negotiations.

The AARC Center as "Encourager"

As emphasized in the AARC Center Strategic Plan, I would underscore the word *encouragement* used in the statement of purpose of the act. Much can be accomplished, in addition to direct outlay of funds, through encouragement at the right place and at the right time.

Political Pressure: Resist it Like the Plague

Equally, I would envision the AARC Center as resistant, and hopefully immune, to political pressure. Many problems in American agriculture can be traced to myths and undue political influence (Browne et al., 1992). And, Gardner (1981) describes how the limiting of power is essential to the renewal process in a society.

Hired to Take Good Risks

The AARC Center has the mandate to take good risks. Historically most good ideas come from individuals, as contrasted to large corporations which often have much political and financial power (Barker, 1993). The AARC Center Board of Directors has an unusual opportunity to support small projects from individuals and small organizations.

Access to Pools of Tens of Thousands of Professionals for Expertise

The tools needed to develop the AARC Center and to implement the spirit of the act will most definitely require the use, by the AARC Center Board of Directors, of expertise from many sources. In this area, I offer my thoughts, not as an evaluation, but more as a suggestion or caution. This is not to imply that errors have been or are being made in this area. It is an assessment which emphasizes the potential seriousness, in the long-run, of lacking sufficient input of the appropriate type, and sufficient accountability.

Based on the information I received, I share the following thoughts:

1. It appears to me that the AARC Center Board of Directors has been operating very close to the letter of the AARC Act of 1990. However, I found *no* evidence that:

   a. the Advisory Council (Section 1661.c) had been appointed.
   b. the Advisory Council had been consulted (Section 1659.b.2) in determining high priority commercialization areas to receive assistance.
   c. use has been made of temporary committees (Section 1659.g.)

2. "The Strategic Plan: A Living Document" looks like a good tool for communication. It appears that the many good ideas are in accord with the letter of the AARC Act of 1990.
3. I have one major concern. It relates to *the processes* of decision making, and *an accountability mechanism* for how those processes are handled. It seems prudent to have all Board of Director decisions concerning policy, priorities, and philosophy (i.e. ethics per Heichel exhibit) open for input and discussion. This should be a continuous process starting at the planning stages, or at least at the pre-proposal stage, and remaining open for continuous evaluation and change in accord with evolving circumstances, new insights, etc.
   - a. It is not clear how thorough or how objective the procedure is for identifying expertise for evaluation of pre-proposals. This involves the elements of both relevance and competence (see Fuglie and Ruttan, 1989). Those decisions set the direction of the AARC Center. Failures in this area may never be traced unless the decision process is designed to be traced. The AARC Center has only one chance to make a first impression. That impression will dramatically affect the ability of the AARC Center to mobilize and leverage the Nation's resources in both the private and public sectors.
   - b. It appears that, for a specific pre-proposal, very few outside experts have been (or may be) involved in the detailed review process before the AARC Center Board of Directors make its decision. Evidence in the literature, such as cited above, demands that U.S. institutions which use taxpayer dollars, and operate with impacts on the environment and the social fabric of the Nation, be accountable for ethical and social aspects of their actions. Therefore, it would seem prudent for the AARC Center Board of Directors to demonstrate sensitivity and leadership for action in these areas.
   - c. No evidence was found that reviewer expertise was being sought (for any pre-proposals) in critical subjects such as ethics or rural sociology. This could be a signal of multiple hazards (e.g. "everybody" makes money except the farmer). I suggest a fundamental weakness in this area is revealed in the AARC Center Strategic Plan under the topic of "Beliefs and Values." The beliefs and values of corporate and political America are evident, but **it is not clear if increased income opportunities for the family farm is a priority objective in the AARC Board of Directors' mindset (or paradigm).**
   - d. It is not clear if there is an accountability system for reviewer evaluation and voting. *It seems essential that all persons influencing AARC Center policies and funding decisions be held accountable.* What do persons involved in deciding how to spend AARC Center funds have to lose if they make poor judgments by not doing homework or consulting experts to obtain information needed for making good decisions? *It is important that both the public and the authors of pre-proposals have assurance of credible accountability policies and procedures in this area.*

The AARC Center: Complexity/Diversity of Projects

Development and commercialization of new crops and products is, virtually by definition, complex. That is one major reason why the AARC Center as an "institution" is necessary—it is a tool for accessing the brain power of our Nation. *Therefore, great care should be taken especially in making decisions about policy, screening of project pre-proposals, and evaluating proposals for regional centers.* Decisions in these arenas can substantially set the course of the AARC Center for a long time to come. The direction can be set both by financial commitment, and perhaps more importantly, by reputation. *Therefore, it seems essential that these policy matters be given wide review, and that persons who make judgments (pro and con) about them be held accountable, at least by reputation, for their ideas, assessments, counsel, and votes (See Heichel reference and quotes in abstract.)* The AARC Center Board of Directors seems to be the place where such a mindset must begin.

Develop and Protect the Credibility of the AARC Center

In my opinion, the policy and pre-proposal review process is the essence of the AARC Center credibility development process by the AARC Center Board of Directors. It is a key aspect of getting a new program started on the right foot. If the AARC Center Director and Board members change in five years, what records will be available regarding how policies were developed and decisions on the priorities and direction of the AARC Center were made?

The rate of movement in getting the AARC Center operational seems to be very good. One hopes that the rapid rate of apparent progress includes an appropriate depth of investment in policy development, pre-proposal assessment, and regional center proposal evaluations. These are complex topics which require much expertise in order to realize the Nation's full potential. Decisions made in these areas during 1992 and 1993 may make or break the future of the AARC Center.

Suggested Hearings

It may be fruitful to have hearings soon on feedback from persons who have had, or tried to have, interactions with the AARC Center. Especially useful could be the perspectives of persons (or organizations) whose pre-proposals were not selected or funded. How were they treated? Have they been encouraged? Have they been helped? How was the process handled? According to a newspaper report, more than 400 pre-proposals were submitted to the AARC Center in response to the first request for pre-proposals. Frankly, it is difficult for me to see how the AARC Center staff could handle that volume of materials with much depth of attention. Pre-proposal reviews by two specialists each, in the areas of business, technology competence, and social/ethical relevance, would require a total of more than 2400 reviews! If applicants' ideas and efforts were handled with excessive haste, it could hinder future effectiveness of the AARC Center.

A future hearing on the subject of investments needed to develop new crops might also be productive for the subcommittee.

VI. SUMMARY AND CONCLUSION

Mr. Chairman, again I congratulate you for your fine work with the AARC Center legislation. It appears that the AARC Center is off and running in good time. My prime concern is the potential lack of accountability at the level of the Board of Directors. It appears that major decisions on AARC Center policy, direction of Board focus, and Board priority of projects and regional center locations may have been made without serious exposure to the perspectives and suggestions of ethicists and rural sociologists.

Therefore, it is recommended that attention be given to the development, as soon as possible, of an accountability system to be helpful and to assure that the activities of the AARC Center Board of Directors also meet the letter (Section 1659.c.) and spirit of the AARC Act of 1990 in the long term.

Mr. Chairman, in order to provide your subcommittee and staff with a more complete record, I conclude my written testimony by inserting below (after the list of exhibits) the three testimonies (minus exhibits) I presented to the AARC Center Board of Directors at the regional public hearing held May 27, 1992 in Portland, Oregon.

Mr. Chairman, it has been a pleasure to attempt to be of assistance in this exciting and very worthwhile venture we now call the AARC Center. Best wishes in your efforts. If I might be of assistance in the future, please feel free to call on me. Thank you.

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IX. LIST OF EXHIBITS

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Busch, L., V. Gunter, T. Mentele, M. Tachikawa, and K. Tanaka. 1993. Socializing Nature: Technoscience and the Transformation of Rapeseed to Canola. A Manuscript. Department of Sociology, Michigan Agricultural Experiment Station, Michigan State University, East Lansing, MI 48824-1111. 19 pages.

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X. TESTIMONIES (3) AT AARC CENTER PUBLIC HEARINGS MAY 27, 1992 IN PORTLAND, OREGON

INVITED TESTIMONY (ORAL SUMMARY) OF GARY D. JOLLIFF [1]

BEFORE THE ALTERNATIVE AGRICULTURE RESEARCH AND COMMERCIALIZATION (AARC) BOARD, OFFICE OF THE SECRETARY, UNITED STATES DEPARTMENT OF AGRICULTURE

PUBLIC HEARING ON GETTING NEW NONFOOD, NONFEED PRODUCTS FROM AGRICULTURAL MATERIALS INTO THE MARKETPLACE RAPIDLY.

May 27, 1992—Portland, Oregon

"How does the AARC Center meet its objectives of commercializing new nonfood, nonfeed products from new crops?" AARC could facilitate the development of incentives for academia, industry, and Government to work together. Horizontal integration of expertise in teams is needed to "tackle" problems. New-crop development plus commercialization often has high risks, long-term demands, and is complex in nature. These characteristics are typically not adequately addressed through traditional channels. The AARC Center could serve to assist in the establishment of the infrastructure to facilitate horizontal integration of expertise to bridge the commercialization gap using the team approach as practiced in Japan.

It is my belief that the AARC Board has the important, and critical, opportunity to become **The Voice for New Crops in America.** As the voice for new-crop development, the AARC Center could serve to develop four key aspects of "infrastructure" for bridging the commercialization gap.

- Develop *Credibility and Visibility:* get the attention and support of industry, academia, and Government. Access U.S. brainpower; identify the best risks.
- Develop *Resources:* Use appropriations to leverage existing resources in industry, academia, and Government (e.g. USDA Competitive Grants for Meadowfoam).
- Facilitate *Cooperation:* Describe, encourage, require, and reward horizontal integration of expertise in industry, academia, and Government.
- Provide *Continuity:* "Staying power" is a key element for success in new venture arenas. Good risks are easy to justify. Avoid the "quick-fix" syndrome.

The result can be strength, quality, coordination, and continuity of effort through sharing of risk, development of opportunities, internal accountability, and innovations. Profitable enterprises, renewable wealth, jobs, and rural development can be achieved. The opportunity presently exists to apply all of these concepts to commercialization of meadowfoam as a new oilseed crop in Oregon. Written testimony with exhibits is provided to the Board.

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INVITED TESTIMONY (WRITTEN) OF GARY D. JOLLIFF [2]

BEFORE THE ALTERNATIVE AGRICULTURE RESEARCH AND COMMERCIALIZATION (AARC) BOARD, OFFICE OF THE SECRETARY, UNITED STATES DEPARTMENT OF AGRICULTURE

PUBLIC HEARING ON GETTING NEW NONFOOD, NONFEED PRODUCTS FROM AGRICULTURAL MATERIALS INTO THE MARKETPLACE RAPIDLY.

May 27, 1992—Red Lion Inn, Jantzen Beach Portland, Oregon

Chairman Andreas, members of the Board, Director O'Connell, Dr. Roetheli, my name is Gary Jolliff. I am both honored and pleased to give testimony today and participate on this panel.

I believe the AARC Board has the important, and critical, opportunity to become: **The Voice for New Crops in the U.S.A.**

I will first give a brief description of my background as related to new crops, reference supporting documents and provide one set of exhibits for the Board's records. This written testimony affirms the need for the AARC Center and supports my oral testimony.

Personal Background

I am a crop scientist engaged in oil yield improvement of the new industrial oilseed crop known as meadowfoam (*Limnanthes*). I have led the meadowfoam domestication and oil yield improvement effort during the last 13 years of its 25-year history [3] at Oregon State University. During the 1980's I served on two national task forces which studied the topic of new crops and reported their findings to the United States Senate. Today I am providing the Board with a copy of those two task force reports [4] for the record. It may be of interest for the Board to know that I was the only crop scientist to serve on both of those task forces. This is mentioned to advise you of the challenge which exists in having adequate representation from the area of new crops for which there previously has been no permanent organized voice. Practically by definition, new crops have not had political voices from commodity organizations, production input suppliers, processors, brokers, and users. For that reason alone, I consider it a special privilege, challenge, and opportunity to testify today on behalf of new crops. It is encouraging to consider the prospect that the AARC Center may be a contact point for advocacy in Washington, DC. In 1987, [5] 1988, [6] 1989, [7] and 1990 [8] I presented testimony before the Senate Subcommittee on Agricultural Research and General Legislation, on topics related to new-crops research and development, and the 1990 farm bill. Copies of written statements and oral testimonies for those hearings are provided today for the record. Two recent publications [9] concerning new-crop development seem especially pertinent: "Strategic Planning for New-Crop Development," and "New-Crop Development: Opportunities and Challenges."

These publications describe some of the opportunities and challenges in new-crop development as well as the need for strategic planning for new-crop development.

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[3] Jolliff, G. D. 1989. Meadowfoam domestication in Oregon: A chronological history. pp. 53-65. In: Hardman, L. L., Jr. (eds.). Strategies for alternative crop development: Case histories. Proc. Symp. Nov. 29, 1988. Anaheim, CA. Center for Alternative Plant and Animal Products. Univ. MN, St. Paul. 72 pages.

[4] 1) *New Crop Development: Needs, Procedures, Strategies, and Options.* Report No. 102. Council for Agricultural Science and Technology. Ames, Iowa. October, 1984. 2) *New Farm and Forest Products: Responses to the Challenges and Opportunities Facing American Agriculture.* A Report from the New Farm and Forest Products Task Force to the Secretary, U.S. Department of Agriculture, Washington, DC. June 25, 1987.

[5] New Uses for Farm Products, S. Hrg. 100-471, June 26, 1987 (pp. 221-329).

[6] The Agricultural Research Commercialization Act of 1988, S. Hrg. 100-832, June 6, 1988 (pp. 58-131).

[7] Jolliff, G. D. 1990. Testimony on funding research, development, and commercialization of new crops. pp. 284-322 and 331-341. In: Preparation for the 1990 Farm Bill—Part IV; Funding of Agric. Research; U.S. Senate Hearing 101-259, Part IV. July 24, 1989. 777 pages.

[8] Jolliff, G. D. 1991. Testimony on HR 47, HR 1505, and HR 2691 regarding new-crop development. pp. 521-523 and 557-576. In: Formulation of the 1990 Farm Bill (Research, Teaching, and Extension Programs). U.S. House of Representatives Hearings. Serial No. 101-30; Part 11. July 19, 1989; Feb. 6, Mar. 7 and 13, 1990. 682 pages.

[9] 1) Jolliff, G. D. 1989. Strategic planning for new-crop development *J. Prod. Agric.* 2:6-13. 2) Jolliff, G., and S. Snapp. 1988. New-crop development: Opportunities and challenges. *J. Prod. Agric.* 1:83-89.

The materials cited above, additional printed exhibits, plus personal experience serve as the basis from which I make my remarks. Now let's address the question at hand.

The Question

"How does the AARC Center meet its objectives of commercializing new nonfood, nonfeed products from new crops?"

Suggestions & Thoughts

By providing incentives for private industry, governments, and universities to work as individuals and as partners to commercialize new nonfood, nonfeed products from new crops.

It is important to recognize that, 1) *the nature of incentives may be very different* for industry, governments, and universities , 2) the *timetables may be different,* and 3) a Federal-level, congressionally mandated entity such as the AARC Center, with the legislated role of risk-taking, may be the only practical way to facilitate the needed incentives.

There are no easy answers or standard recipes to use on a broad scale in all projects. However, there are basic principles which should provide guidance in the search for project-specific answers. At the risk of oversimplification and appearing biased, I offer the following thoughts:

- Excess production of food and feed crops is a global problem.
- American farmers need profitable crop alternatives to surplus commodities.
- Congress wants to provide leadership in giving farmers alternatives.
- New-crop development would contribute to the local and global communities.
- The European Community has increased emphasis on new-crop development.
- New-crop development is long-term and high-risk, thus requires joint ventures.
- The "short-term return on investment" mentality is unfriendly to new crops.
- Historically, crises precipitated support for new-crop development.
- Production-marketing-consumption infrastructure may be complex for a new crop.
- A holistic approach to new-crop development could reduce risks.
- The United States should not expect farmers to take the lead to develop new crops.
- Incentives are fundamental to making investments.
- Profit is a prime incentive in private business; ways to profit must be found.
- New-crop development efforts need support on par with established crops.
- Federal support of new-crop development is appropriate and essential.
- The AARC Center represents an institutional innovation by the U.S. Congress.
- The congressional mandate for the AARC Center to take good risks is excellent.
- New crops can add to national wealth, thus the public benefits.
- The United States has the technology and plant resources to develop new crops.
- At least one success in the short run would boost morale.
- The temptation of expecting quick successes is a hazard [Anticipointment].
- The AARC Center should speak for new crops in a timely and authoritative manner.

With this background, I would like to now draw your attention to the publication entitled "Strategic Planning for New-Crop Development." Please refer to the abstract printed at the top left column on the front page, which reads as follows:

> The high cost of chronic agricultural commodities surpluses justifies immediate national attention to strategic planning and the development of new crops. The need is urgent to diversify the crop plant base from which the United States generates its annually renewable wealth. The technological tools and plant resources are available, but as yet, neither adequate federal appropriations nor a sufficiently forceful congressionally authorized management entity has been forthcoming. The Foundation for New Farm and Forest Products has been proposed as an essential institutional change for orderly development and commercialization of profitable new crops to diversify U.S. agriculture."

Congress has formed the entity. It is the AARC Center. That may have been the most difficult part of the job. However, the other parts of the task will not be easy. Clearly, passing legislation to form the AARC Center was the most important part of the overall task. Because, having an advocacy for those who do not have a voice in Washington, DC is a prerequisite to progress for new-crop development. Apparently, progress is being made to improve levels of Federal appropriations. But, resources are now a critically important component.

RECOMMENDATIONS

Become an informed advocate for development of new crops

Unfortunately, research work funded on new crops historically has reflected support which typically is unrealistic in both low levels of resources and brief timeframes for needed accomplishments. This implies that, compared to past projects, future projects need more information available at the outset. Accessing expertise from throughout the Nation is important. The AARC Board could serve to examine history and previous work with other crops to establish more realistic perspectives in levels and duration of funding. Efforts should be made to avoid contributing to "anticipointment."

Be the VOICE which is "in the right place at the right time."

In its role as advocate for development and commercialization of new crops the AARC Center could play a key role in assessing the investment levels needed to accomplish the needed outcomes on a realistic timetable, even when involving cooperators. By definition, new crops involve much in the realm of the unknown.

Advocate specific programs to mobilize our Nation's existing brainpower

For example, the AARC Center could propose legislation, or USDA policy, to provide competitive grant funds (through traditional channels) restricted to specific new crops, and possibly even restricted to specific priority problem topics which need solutions to enhance commercialization.

Work through Regional Centers

This should encourage participation and cooperation at the regional, State, and local levels.

ORGANIZATIONS AND SYSTEMATIC DISTORTION OF INFORMATION

By David A. Bella,[1] M. ASCE

ABSTRACT: Modern society depends upon organizational systems for much of its information, particularly with respect to the assessment of large scale technological projects. It is reasoned that organizations tend to distort information to meet organizational needs. Such distortions do not depend upon dishonest behavior on the part of individuals. Rather, tendencies to distort information are systemic properties of the organizational systems themselves. As the power of modern technology grows, the consequences of distorted assessments become more serious and potentially catastrophic. The shuttle explosion and the nuclear reactor accident at Chernobyl provide tragic lessons.

INTRODUCTION

We live in a time when large and complex technological systems of immense power are developed and operated by vast organizational systems. These technological systems are beyond the capacity of any individual to fully understand, much less control. We thus depend upon organizations in a fundamental way. They do what we as individuals, communities, and groups cannot do. This is dependency.

But how do vast organizational systems differ from the people who work within them? Have we turned over responsibility to these organizations? Can we trust such organizational systems given the tremendous power of modern technology? Are such organizations really under human control or is it the other way around?

THESIS

It is the thesis of this paper that modern organizational systems, by their very nature, distort information to meet organizational needs. Moreover, such systematic distortions do not require unethical behavior on the part of individual persons. The distortion of information is not merely the outcome of individual or group intent. Distortion of information is often a systemic property of organizational processes sustained by basically good people. The technological consequences of such distortions can be disastrous.

To understand this thesis, one must realize that organizations are processes that are sustained through the day-to-day practices of many individuals. Each individual has only a local view of the organization and the work that goes on within it. The view that I have of Oregon State University depends upon the tasks I perform, the people I associate with, and the information I receive. My view is different from that of a student,

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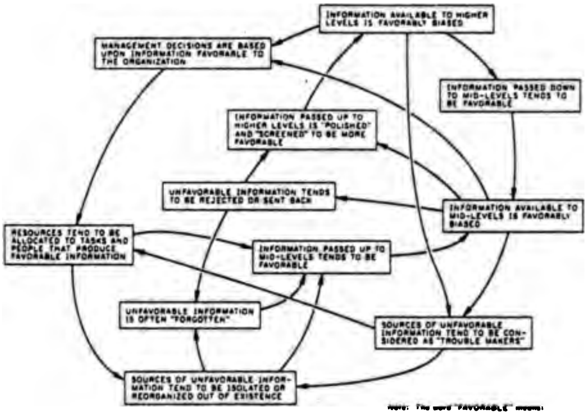
Note. Discussion open until March 1, 1988. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on February 24, 1987. This paper is part of the *Journal of Professional Issues in Engineering*, Vol. 113, No. 4, October, 1987. ©ASCE, ISSN 0733-9380/87/0004-0360/$01.00. Paper No. 21879.


INFORMATION AVAILABLE TO HIGHER LEVELS IS FAVORABLY BIASED
MANAGEMENT DECISIONS ARE BASED UPON INFORMATION FAVORABLE TO THE ORGANIZATION
INFORMATION PASSED DOWN TO MID-LEVELS TENDS TO BE FAVORABLE
INFORMATION PASSED UP TO HIGHER LEVELS IS "POLISHED" AND "SCREENED" TO BE MORE FAVORABLE
UNFAVORABLE INFORMATION TENDS TO BE REJECTED OR SENT BACK
INFORMATION AVAILABLE TO MID-LEVELS IS FAVORABLY BIASED
RESOURCES TEND TO BE ALLOCATED TO TASKS AND PEOPLE THAT PRODUCE FAVORABLE INFORMATION
INFORMATION PASSED UP TO MID-LEVELS TENDS TO BE FAVORABLE
UNFAVORABLE INFORMATION IS OFTEN "FORGOTTEN"
SOURCES OF UNFAVORABLE INFORMATION TEND TO BE CONSIDERED AS "TROUBLE MAKERS"
SOURCES OF UNFAVORABLE INFORMATION TEND TO BE ISOLATED OR REORGANIZED OUT OF EXISTENCE

NOTE: The word "FAVORABLE" means: supporting the ambitions and survival needs of the organization

FIG. 1. System Distortion of Information within Organization

dean, or university president. Our environments (Bandura 1978) or "climates" (Field and Abelson 1982) are different. Regardless of who we are or what our position is, our own view of the organizational system that we work within is a local view from within the internal environment that the system itself provides. It is this view that shapes our perceptions and even our beliefs (Salancik and Pfeffer 1978). In a large organization, this is a restricted view indeed (Silver and Geller 1978). Because each of our views is so limited, it is important for us to occasionally step outside our organizational niche to reflect upon these systems that our society increasingly depends upon.

MODEL

To better understand complex systems, we often construct models that by definition are simplified representations of some important features of real world systems. Such a model is shown in Fig. 1.

Instructions for reading Fig. 1 are as follows:

1. Start by reading any statement.
2. Move from that statement along an arrow to a connecting statement.
3. If you move forward along an arrow, insert the word "therefore."
4. If you move backward along an arrow, insert the word "because."
5. After following an arrow (forward or backwards) to a statement, read this statement.
6. Repeat steps 2–5 as shown above.
7. Read your way through the entire figure moving forward or backward on arrows as you wish until you have gone through, at least once, as many loops and cycles as you can find.

This model refers to a typical organization that includes several management levels and a variety of technical specialists. This model describes the tendency of organizational systems to distort information through the normal practices of its members, practices which from the local view of each participant appear reasonable and proper. That is, the model claims that organizational processes distort information not through the malicious intent of its members but rather as a collective and systemic consequence of many individual actions by members who each see their own actions as proper and necessary. By following the outlined steps, one should grasp the nature of the system modeled in Fig. 1.

After (and only after), reading through Fig. 1, with some reflection, conduct the following mental experiment. Assume that a very biased environment impact study has been produced by an organization as a consequence of the organizational behaviors described in Fig. 1. Imagine that you have read this report and are disturbed by its biased results. You learn that information unfavorable to the organization was omitted from the report. You decide to determine who is responsible. Thus, you question all of the participants in the system including top and mid-level managers, professionals, and the particular individual (the "troublemaker") who had reported the unfavorable information. Your questions and the responses of participants are given in Table 1.

Compare the responses in Table 1 to the system of Fig. 1. The responses are not dishonest; they reflect the actual experienced environments of participants. That is, each participant works within a local environment of the organizational system. Within this environment, each perceives his or her own actions to be reasonable and responsible. Such perceptions are no doubt reinforced by peers within these work environments. But, despite the responses of Table 1, the overall system (Fig. 1) still produces distorted information. This is systematic distortion.

If you are tempted to criticize the characters of Table 1 for not taking a broader view and not deliberately seeking out unfavorable information, some honest reflection is called for. Are the behaviors of these characters really that different from the many people that we've all met and worked with? Are we that different? Do professionals really take a broad view rather than focusing upon their specific assignments? Do managers really have the time or the ability to review the technical material of their professional staff? Are behaviors that differ from the characters really encouraged and rewarded within organizational processes? Do we even have time to take a broader view and ask "unfavorable" questions? Do "troublemakers" really get ahead? I admit to important exceptions, but for the most part, an answer of "no" to these questions appears to be more honest.

EVIDENCE

One of the best studies on such behaviors is described in a report entitled, "An Examination of the Moral Dilemmas of University Scientists Participating in the Preparation of Environmental Impact Statements" (Matzke 1976). This study traced information through the organizational process and found the following. (Note: the term "scientist" also referred to engineers.)

One might apply these concepts to various disciplines, businesses, or socio-political organizations.

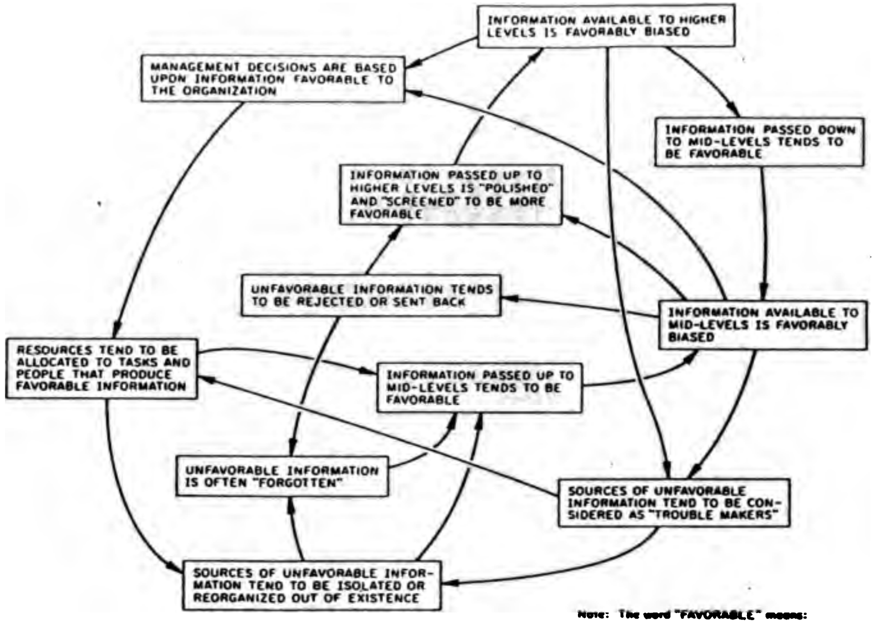

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FIG. 1. System Distortion of Information within Organization

TABLE 1. Organizational System (Fig. 1) as Seen from Within (Assume that Biased Report Has Been Produced by System)

Person in system (Fig. 1) (1)	Question addressed to person (2)	Answer to question from person addressed (3)
Higher-level manager	Why didn't you consider the unfavorable information your own staff produced?	I'm not familiar with the information that you're talking about. I can assure you that my decisions were based upon the best information available to me.
Midlevel manager	Why didn't you pass the unfavorable information up to your superiors?	I can't pass everything up to them. Based upon the information available to me, it seemed appropriate to have this information re-evaluated and checked over.
Professional technologist	Why wasn't the unfavorable information checked out and sent back up to your superiors?	That wasn't my job. I had other tasks to do and deadlines to meet.
"Troublemaker"	Why didn't you follow-up on the information that you presented?	I only worked on part of the project. I don't know how my particular information was used after I turned it in. I did my job. Even if I had all the information, which I didn't, there was no way that I could stop this project.
Higher-level manager	Why has the organization released such a biased report?	I resent your accusation! I have followed the development of this report. I have reviewed the drafts and the final copy. I know that the report can't please everybody but, based upon the information available to me, I can assure you that the report is not biased.
Midlevel manager	Why has the organization released such a biased report?	It's not just my report! My sections of the report were based upon the best information made available to me by both my superiors and subordinates.
Professional technologist	Why has the organization released such a biased report?	It's not my report! I was involved in a portion of the studies that went into the report. I completed my tasks in the best way possible given the resources available to me.

TABLE 1. *Continued*

Person in system (Fig. 1) (1)	Question addressed to person (2)	Answer to question from person addressed (3)
"Trouble-maker"	Why has the organization released such a biased report?	Don't ask me! I'm not on this project anymore and I really haven't kept up with the project. I turned in my report. It dealt with only a part of the project.
Higher-level manager	Why was the source of unfavorable information (the "trouble maker") removed from the project?	I hardly know the person. A lot of people have worked on this project. I must, of course, make decisions to keep this organization running, but, there has been no "plot" to suppress people! On the contrary, my decisions have been objectively based upon the available information and the recommendations of my staff.
Midlevel manager	Why was the source of unfavorable information removed from the project?	I don't like your implications! I've got tasks to complete and deadlines to meet with limited resources. I can't let everybody do "their own thing"; we'd never finish anything. I base my recommendations and assignments on the best available information!
Professional technologist	Why was the source of unfavorable information removed from the project?	I'm not sure about the details because I don't work with him. I guess that it had something to do with a reorganization or a new assignment. He is a bright person, somewhat of an eccentric, but I've got nothing personal against him.
"Trouble-maker"	Why were you removed from the project?	My assignment was completed and I was assigned to another project. I don't think that anybody was deliberately out to get me. My new job is less of a hassle.

Research that has a negative effect on the project is challenged, contracted to another group of scientists, or explained away—on the other hand, favorable research is subject to no such scrutiny and in several instances purely speculative discussions are introduced that have positive conclusions based on no hint of evidence. (pages 36–37)

Even if research is conducted with acceptable objectivity, the

> probability is moderately high that it will be compromised during circuitous transmittal to the public. (page 38)

Interviews and a questionnaire revealed that the (individual) scientists and engineers involved in the studies accepted moral obligations including an obligation to not participate in studies which must agree with externally imposed conclusions. Despite such findings, the study concluded the following:

> Few of the originating scientists were aware of the disposition of their research, beyond the point at which they submitted their reports. Primary value seemed to be placed on meeting the contractual obligations, fulfilled by one's report, as opposed to the larger societal obligation that would be met by production of a full-disclosure environmental document. (page 100)

In other words, the scientists and engineers primarily responded to their immediate organizational environment and its demands. The conclusion then went on to state:

> Seemingly, they upheld the ideal of scientific values and moral responsibilities, but largely perceived themselves as contract laborers who held to these values only insofar as was possible within terms of their contracts. If society expects that scientific participation ensures high standards, it is liable to be disappointed. (page 103)

The model (Fig. 1 and Table 1) was developed in 1979 by the writer to describe environmental-impact assessments. The model has been found to fit the experiences of many people within different organizations, and it is consistent with the cited study. A number of events, however, indicate a much wider applicability than originally intended.

Information on the shuttle disaster (the explosion of the Challenger on Jan. 28, 1986) indicates that prior to the accident, the National Aeronautics and Space Administration (NASA) behaved in a manner quite similar to that of Fig. 1 and Table 1. It appears that, given the pressures on NASA to meet a launch schedule, information concerning the possibility of technical failures (including the solid rocket joint failure implicated as a cause of the explosion) was treated as "unfavorable" and systematically filtered out (Presidential Commission 1986). More favorable "can do" information that minimized or ignored risks was selectively favored by the system in a manner not unlike that of Fig. 1.

The Presidential Commission (1986) established to investigate the causes of this accident found that:

> The Space Shuttle's Solid Rocket Booster problem began with the faulty design of its joint and increased as both NASA and contractor management first failed to recognize it as a problem, then failed to fix it and finally treated it as an acceptable flight risk.

On the very night before the launch, engineers familiar with the booster joint argued against the launch because of the possible adverse effect of low temperature. Such information was filtered out; it never reached those who made the launch decision.

The systematic filtering of unfavorable information had a long history in the shuttle program. Over time, such systematic filtering shaped the perceptions of the managers. The result was systematic self-deception concerning the risk of catastrophic failure. Commission member Richard Feynman (1986) observed:

> It appears that there are enormous differences of opinion as to the probability of failure with loss of vehicle and of human life. The estimates range from 1 in 100 to 1 in 100,000. The higher figures come from working engineers, and the very low figures from management.

A thousand-fold difference in perceived risks involves a great deal of systematic self-deception. The evidence indicates that the managers, caught up in the system and protected from unfavorable information, actually believed that these low probabilities of failure (1 in 100,000) were reasonable. The historical failure rate of solid-fueled boosters at the time was approximately 1 in 25. The shuttle had two solid boosters (Feynman 1986).

Such systematic distortions influenced decisions in ways favorable to NASA's need to meet flight schedules (McConnell 1987). The price was an increasing risk of catastrophic failure. But information concerning such risks was filtered out right up to the time that the shuttle was launched. Commenting on the certification criteria designed to assure safety, Feynman (1986) concluded that: "Subtly and often with apparently logical arguments, the criteria are altered so that flights may still be certified in time."

Newsweek magazine described the shuttle explosion as "the paradigmatic blunder of the late 20th century" (Adler 1986). This same year, 1986, produced another technological blunder of global proportions, the explosion at Chernobyl. Information on the Chernobyl nuclear reactor disaster, though limited, indicates similar organizational behaviors. The deficiencies of the Soviet reactor were known many years before the accident (Bohlen 1986). There is evidence to believe that Soviet managers suffered from similar systematic delusions concerning risks. As an indication, they had decided to locate nuclear power plants near major cities despite objections from their own scientists.

Actual organizations are, of course, far more complex than the model given above. One must be concerned with actual organizational complexes [as in "Military-Industrial Complex" (Eisenhower 1961)] that include many organizations, consultants, and advocates within self-reinforcing systems (Bella 1986). These are adapting systems that change over time.

These added complexities, however, do not alter the basic message of the model presented herein. A more comprehensive model of adapting organizational complexes leads to the conclusion that (Bella 1986):

Organizational complexes tend to systematically distort information while sustaining compatible internal environments within which people perceive that their own behaviors, actions, and decisions are responsible, reasonable, and justified.

The extent and consequences of such distortions may vary, but the tendency to selectively produce, sustain, and distribute information favorable to their own needs appears to be a generic property of the organizational systems upon which our society depends.

"KEEP THE SYSTEM GOING"

The human fault that leads to the distortion of information is not limited to willful deceit. Individual honesty is necessary but insufficient to prevent the widespread distortion of information. The human fault of concern is more insidious than willful deceit. This fault involves the acceptance of a life that involves merely completing one's assignments. This hardly sounds untrustworthy, much less dangerous, but it is this "functionary" behavior that allows systematic distortions to occur.

The characters of Table 1 were doing their assignments. Through their day-to-day devotion to their assignments, they systematically protected each other from unfavorable information. With time, their perceptions were shaped by the information that the system fed them.

As a general rule, perceptions are systematically shaped to "keep the system going." As an example, immediately prior to the launch of the shuttle Challenger, a shift in perception occurred that kept the system (the launch process) going despite the awareness of serious technical problems that later contributed to the explosion. Prior to the launch, an unconscious shift in perceptions occurred from "do not launch until you can prove the rocket is safe" to "launch unless you can prove that the rocket will fail" (Presidential Commission 1986). It was impossible to prove that the rocket would fail. In fact, five out of the six solid rocket joints did not fail. Not being able to prove failure, the "unfavorable" information concerning the possible adverse effects of low temperatures on the solid rocket seals was not passed up to those who made the launch decision. "Unfavorable" information was "filtered out."

In the case of the Chernobyl nuclear reactor explosion, the perception "keep the system going" appeared to have been a significant factor (Rippon 1986). Operators were running tests on the reactor that required them to power-down the reactor. They were under pressure to complete the tests at this time. At 2:00 p.m. on April 25, the operators were ready to conduct a second test but, at the request of a dispatcher at a power-distribution system, the test was delayed. At 11:10 p.m. the load demand was lifted, and operators prepared to resume the test. To conduct the tests, they attempted to power-down the reactor. This particular type of reactor is difficult to operate at partial power. The power dropped far more than required for the test. As the power dropped, the operators took "corrective" steps to "keep the system going." By approximately 1:00 a.m. they appeared to have stabilized the reactor at a reduced power level and proceeded with the test. As the test proceeded, a sudden power surge occurred apparently as a result of a "positive void effect," a fundamental design fault that had been pointed out to the Soviets years before (Bohlen 1986). The power surge could not be controlled quickly enough because of the steps that the operators had taken to "keep the system going," steps that were later described after the accident, as improbable, unpredictable, careless, gross violations, and absurd (Bohlen 1986; Hilts 1986). The reactor exploded, spreading huge amounts of radioactive material over a large area (Rippon 1986; USSR·Commission 1986).

The lessons are disturbing. Organizational systems filter information so as to protect their members from information unfavorable to the system itself and its behaviors. Organizational systems shape the perceptions and beliefs of those within the organizations in ways that "keep the system going" even when catastrophic outcomes are involved. In hindsight, of course, after the disaster itself has shaped our own perceptions, we can look back and criticize the immediate decisions that led to the disaster. But such hindsight cannot be accepted as a means of avoiding disaster before it actually occurs.

While there are many steps that can be taken to reduce the probability of technological disasters, in the end we must recognize that organizational systems insidiously transform the perceptions, beliefs, and practices of the best of us. To deny this is to deny the tragic lessons of recent history and to turn over responsibility to the organizational systems that mold us to "keep the system going." Systematic self-deception should be considered more the rule rather than the exception.

IMPLICATIONS

The shuttle and Chernobyl explosions demonstrate that the concerns raised in this paper are not without practical merit. The tendencies of organizational processes to selectively favor information that meets its needs can lead to tragic consequences. As tragic as the shuttle loss was, it could have been much worse. The flight planned for the following May would have carried its first radioactive package; two radioisotope thermoelectric generators containing a total of more than 40 lb of plutonium-238 (Marshal 1986). A weather change could have made the accident at Chernobyl far worse.

Modern technology has no doubt produced many benefits, but it has also made us more dependent upon organizational systems and expanded the possibilities for technological catastrophe. The shuttle and Chernobyl tragedies are signs of the age we live in. In both cases, society depended upon large organizational systems to assess, design, and operate complex technological systems. In both cases systematic self-deception occurred. In both cases the risks of catastrophic failures were believed to be exceedingly low while at the same time, deficiencies were systematically ignored. In both cases, the general behaviors illustrated in the model of Fig. 1 and Table 1 led to tragic outcomes.

Organizations do, of course, provide essential social services. They are needed to sustain the technological systems upon which our lives depend. The inertia of large organizations often provides a check against incompetence, fanaticism, and greed. Nevertheless, deficiencies must be recognized.

There is disturbing evidence that modern organizations display two systemic properties. They have the capacity to: (1) Develop complex technological systems of immense power; and (2) sustain widespread self-deception concerning the catastrophic risks of such technological systems. Taken together, such properties imply that the modern organizational system has an inherent deficiency. An organizational system is incapable of adequately addressing the catastrophic possibilities of its own technological accomplishments!

Engineers and scientists have important roles to play in providing independent checks and balances needed to correct organizational distortions so that such catastrophies can be avoided. But, if this is to occur in a trustworthy manner, we must assure that the bodies of knowledge that constitute our professional expertise are not themselves the product of these very same organizational distortions. This is not a simple task (Bella 1987). As a first step, this task requires us to reconsider our responsibilities as individuals, professionals, and citizens.

By limiting one's inquiries and questions to one's assignments, one turns one's mind over to the system to be shaped to meet the needs of the system. One becomes a functionary of the system not by compromising one's beliefs, but rather, by turning responsibility for one's perceptions and beliefs over to the system. The fault does not lie in accepting assignments. Rather, the fault lies in limiting one's own responsibilities to such assignments. Responsible persons must always do more than their assignments (Ladd 1982). They must accept responsibility for inquiries and questions that go beyond their assigned tasks. This can be personally risky and uncertain, but to give up such responsibilities is to accept the role of the functionary, a person who has limited responsibilities to the performance of assignments (Bella 1987).

As individuals, professionals, and citizens, how can we be responsible nonfunctionaries in an age when complex and powerful technologies are developed and operated by vast organizational systems? How can education prepare people for such an age? How are we to be more than mere functionaries who "keep the system going?" These are difficult questions. To avoid them involves grave risks.

CONCLUSION

Organizations tend to systematically distort information in self-serving ways. Such distortions do not depend upon deliberate falsifications by individuals. Instead, people who are competent, hard-working, and honest can sustain systematic distortions by merely carrying out their organizational roles. Unchecked by outside influences or the undeniable realities of catastrophic failures, organizational systems can sustain self-serving distortions. The potential for catastrophic consequences is significant.

A technological culture faces two choices. First, it can wait until catastrophic failures expose systemic deficiencies, distortions, and self-deceptions. The Challenger and Chernobyl explosions did this. Second, a culture can provide social checks and balances to correct for systemic distortions prior to catastrophic failures. This second more desirable alternative, however, requires the active involvement of independent engineers and scientists. They must ask "unfavorable" questions and pursue "unfavorable" inquiries. Without such initiatives, checks and balances are undermined and catastrophic possibilities are likely to increase as the scope and power of organizational technology expands.

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SOCIALIZING NATURE:

Technoscience and the Transformation of Rapeseed into Canola

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ABSTRACT

While the constructedness of manufactured products is obvious, plants and animals retain their "naturalness" even as they are transformed. Yet, there is little doubt that the transformation of plants is a powerful method by which we socialize nature such that it better suits our purposes. This paper examines the transformation of rapeseed from a minor crop used largely for marine lubricants into a major global competitor in edible oil markets. This transformation was brought about in part by the elimination of two components defined as potentially toxic, erucic acid and glucosinolates, as well as by changes in the location of production, processing techniques, and its suitability for planting and harvesting using equipment designed for wheat. Of particular note is the role of the Canadian State in providing large-scale financing necessary for the research to transform the commodity from a specialty crop into a bulk commodity.

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I. Introduction

Conventional studies of the introduction of technical change in agriculture focus almost entirely on the role played by individual farmers (e.g., Rogers, 1983). In a parallel way, most of the literature in the sociology of science (e.g., Latour, 1987; Knorr-Cetina, 1981; Bijker, Hughes, and Pinch, 1987) tends to focus on the production of science with little analysis of the incorporation of its products into the larger social world at a later date.[1] Furthermore, Latour tends to provide a supply-oriented view of science in which scientists develop new ideas or machines and enroll others in their use (Latour, 1984). In contrast, Krohn and Schafer (1983) provide a demand-oriented approach in which various extrascientific actors direct the research process. In a recent work, Busch et al. (1991) propose an "economic" model of science. They argue that science has a supply and a demand, both of which are heterogeneous and hypothetical. Moreover, this supply and demand are mediated not (always) through the market, but through negotiation, coercion, and persuasion.

Moreover, while a substantial body of literature on commodity subsectors has developed in both sociology (Friedmann, 1982; Charvet, 1988; Friedland and Barton, 1975; Friedland, Barton and Thomas, 1981; Bertrand, 1988; Heffernan, 1984) and agricultural economics (Goldberg, 1968; Shaffer, 1968; Byé and Mounier, 1984; Griffon, 1990; Marion, 1984), it only occasionally touches on issues of technical change and then usually as a "black box" that impinges on social and economic organization.

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[1] Latour suggests that most of what happens occurs after what is commonly known as science is completed, but he has not followed that road to date. His forthcoming volume, Aramis ou l'Amour des Techniques (%Latour, forthcoming), may be his first step in that direction.

Nevertheless, there is little doubt that governments, corporations, foundations, and private individuals, spend large sums of money every year in creating, developing, producing, and marketing scientific and technical changes. There is equally wide agreement that only a handful of these attempts succeed in (1) generating the necessary funds for research, (2) bringing the research to its successful conclusion, and (3) making the difficult transition from a research product to a commonly used good.

In this paper we examine the case of canola (rapeseed), a widely grown and utilized oilseed whose current form is largely the result of scientific research. Canola is now prized as an excellent edible oil and an important source of protein for animal feed. The transformation that made this possible was in large part the result of an unlikely intersection of plant breeding, lipid chemistry, chemical engineering, and human nutrition.

In Latour's (1987) work he has asserted that scientific arguments are like chains: only as strong as the weakest link. He further argues that "Every time a fact is verified and a machine runs, it means that the lab or shop conditions have been extended in some way" (Latour, 1987:250). Yet, Latour stops short of taking the final step and analyzing how technoscience is extended to the point where a new product or process becomes widely used. It is this process that is the center of our story, for it is here that the distinction between science and society, between laboratory and factory becomes blurred.

For brevity we present the story as follows: First, we introduce the characters that inhabit this particular technoscientific world. Then, we briefly sketch the elements of the drama that emerges as rapeseed is transformed into canola. Since canola is known as the Cinderella crop, we use the story of Cinderella as a guide to our own story.[2] In this story erucic acid and glucosinolates are the wicked stepmother and evil sisters, respectively, the scientists are the fairy godmothers, the gas chromatograph the magic wand, and the consuming public the Prince that takes Cinderella away to a new life. Finally, we shall examine the way in which technoscience was subordinated to other concerns even as it was crucial to the project at hand.

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[1] While the dramaturgical approach has been championed by %Goffman (1974) among others, we do not use it here in the same sense. In particular, we reject the idea of "fronting" as a continuing activity, arguing instead, like %Huizinga (1950) that culture is itself a form of play.

THE ACTORS (IN APPROXIMATE ORDER OF APPEARANCE):[3]

Rapeseed (later transformed into canola). Rapeseed is an oilseed of Asian origin. It is commonly cultivated in India, China, and north central Europe where it has been grown for centuries for use as a lamp oil and for cooking. But unlike most crops that crossed the oceans at least several centuries ago (see Brockway, 1979), rapeseed (*Brassica campestris*) was only introduced into Canada by Fred Solvonik, a Polish immigrant, in 1936 (Bell, 1982) and by the Canada Department of Agriculture (*Brassica napus*) prior to World War II. Rapeseed is known as Canada's "Cinderella crop." Like Cinderella, it went to the ball in a carriage that would turn into a pumpkin at midnight. Happily two fairy godmothers (read scientists) intervened with a magic wand (the gas-liquid chromatograph) in the nick of time and transformed her into canola.

Erucic Acid (the Wicked Stepmother) and **Glucosinolates** (the Evil Stepsisters). These compounds, found in significant quantities in rapeseed, presented apparent health problems for humans and farm animals, respectively.

The Canadian National Research Council (CNRC). The CNRC is an organization that supports scientific research in a wide range of fields. Like the Centre Nationale de Recherche Scientifique in France, it maintains its own laboratories. In addition, until recently, the CNRC had Associate Committees organized around particular issues of public concern. Among them were the Associate Committee for Fats and Oils and the Associate Committee on Animal Nutrition.

The Prairie Research Laboratory (PRL). This laboratory was home to Burton Craig, a biochemist. He collaborated with Keith Downey, a plant breeder at the Forage Research Laboratory (FRL), also located in Saskatoon, on a plan by which to transform rapeseed into a new product that came to be called canola. The PRL was also home to Clare Youngs (a chemical engineer) and Leslie Wetter (a biochemist), who developed new crushing methods that made rapeseed oil suitable for margarine production. These methods were adopted by food processors in Europe (Gray, 1979).

The Food and Drug Directorate (FDD). The FDD is the Canadian equivalent of the US Food and Drug Administration. It is responsible for insuring the health and well-being of the Canadian population by prohibiting the sale of potentially harmful food products. Over the years, the FDD voiced concern about the public health issues associated with the widespread use of rapeseed oil.

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[3] As will be apparent to the reader, it is unclear as to just where to draw the line in identifying actors since virtually all the actors can be decomposed into smaller actors. The analogy with %Latour's (1987) black boxes is an appropriate one.

The UWO Endocrinology Laboratory. Dr. Kenneth Carroll of the University of Western Ontario was interested in the development of new kinds of drugs. Having explored the pharmaceutical use of other long carbon chain compounds, he was drawn to erucic acid, which is found in abundance in rapeseed.

Sprague-Dawley male rats. These rats, bred as laboratory specimens, were the animal of choice for Carroll's experiments with erucic acid. When these rats were fed a high erucic acid diet, their adrenal cholesterol was elevated and their growth slowed.

Canadian Rapeseed Farmers. Located mainly on the Canadian plains in Sasketchewan, Manitoba and Alberta, these farmers grew rapeseed during the Second World War for use as a marine lubricant. After the war the demand for marine lubricants fell due in part to the reduced size of the navy and in part to the switch from steam to diesel engines.

Canadian Food Processors. Because it offered a domestic source of supply, the oilseed crushing industry conducted research on the utilization of rapeseed oil in margarines, shortenings, and salad oils beginning in the mid-1950s. The industry bore a large share of the cost in terms of finance, expertise, personpower, plant and equipment, production time, and testing and quality evaluation (Boulter, 1983).

The Defence Research Board. After the end of World War II the DRB was charged with insuring the safety and adequacy of military rations as well as maintaining domestic food security for Canada. A significant aspect of that work involved checking to see that all key ingredients in the diet were produced in sufficient quantities in Canada.

The French Laboratory. This laboratory, along with **The Dutch Laboratory,** confirmed previous studies that suggested that high erucic acid rapeseed oil had deleterious effects on laboratory animals. Rocqueline, Martin, and Cluzan (1970) found that Wistar rats (a variety of laboratory rat) fed high erucic acid rapeseed oil had a significantly lower growth rate than animals fed other oils including low erucic acid rape (LEAR) oil. They also found that erucic acid appeared responsible for myocarditic lesions although LEAR oil also caused cardiac damage to a lesser extent. However, they did not find significant differences in the weights of tested organs and tissues as in previous experiments. Moreover, the Dutch team of Abdellatif and Vles (1970) demonstrated that rats fed rapeseed oil developed fatty depositions in the heart and skeletal muscle fibers. They argued that "... the pathological effects of conventional RSO are caused by its erucic acid content" (1970:433).

Farm animals (pigs and chickens). These animals were unable to digest rapeseed meal without developing thyroid problems.

The Canadian animal feed producers. As an industry that supplies the animal industry, the feed producers were unimpressed by the performance of rapeseed meal as compared to soybean and other forms of meal. Without their blessing, rapeseed would just be a pretty flower rather than the foundation of an industry.

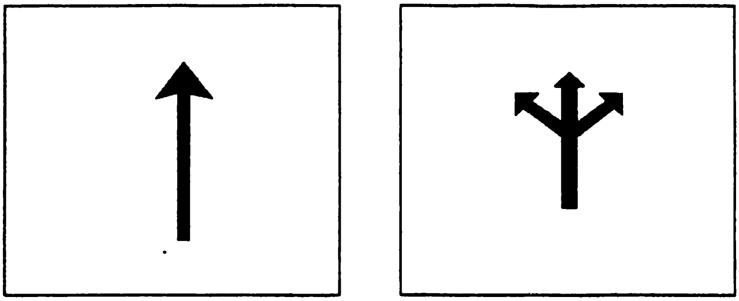
The Federal Department of Industry. Upon its foundation in 1964, it identified rapeseed as a potential high-growth industry. The department established the Rapeseed Utilization Assistance Program. That, in turn, helped in the formation of **The Rapeseed Association of Canada** in March 1967 to promote the use of rapeseed and its products. The association encompasses the entire spectrum of parties interested in any way in rapeseed including researchers, growers, handlers, exporters, marketers, crushers, refiners, and feed manufacturers. The association contributed greatly to the research effort for developing canola. The association was reorganized as the Canola Council of Canada in July 1980 when "double-zero" rapeseed received a new name, "canola."

The Canadian Railways. The railways insisted that only grains were eligible for the "Crowsnest Pass," a freight rate considerably lower than that for other goods. Only through legislative mandate were the railroads to change their rules and then only to accept seed and meal. Rapeseed oil remains subject to the higher tariff.

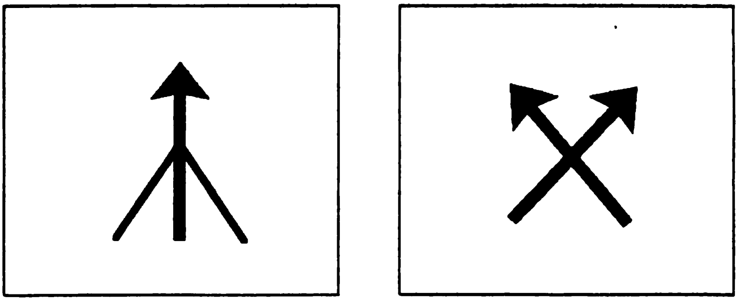
II. A Social/Natural History of Rapeseed

The history of the transformation of rapeseed in Canada is usually touted as one of the great success stories of Canadian science. Without a doubt, this is the case. However, a careful examination of the situation leaves us with not one but several interrelated stories. We may think of the trajectories of on-going scientific research programs as following one of four paths as illustrated in Figure 1. The most simple is for it merely to continue along the same path down which it was originally headed. A second possibility is branching, the situation that drives Robert Pirsig (1974) mad in his autobiographical novel, Zen and the Art of Motorcycle Maintenance. A third possibility is convergence, where two or more lines of research converge to form a single research trajectory. Finally, two or more lines of

Figure 1. Alternative Trajectories for a Continuing Research Program.



a. continuous b. branching



c. convergent d. crossing

research may simply cross, in that while information about one line is known to practitioners of the other, the two lines never become fully integrated. As we shall see, this fourth possibility appears best to describe the case of the transformation of rapeseed into canola.

The insecurity of transatlantic transportation during World War II led to a shortage of marine lubricants. Rapeseed oil served that purpose quite satisfactorily. By virtue of its high content of erucic acid, it sticks to metals even under extreme heat and humidity--the kind of conditions frequently found in the engine rooms of large vessels. The shortage led the Canadian government to encourage the planting of rapeseed through a price support program. Polish seed imported by Solvonik, and other seed acquired from Argentina, formed the basis of the Canadian government program. Significant quantities of rapeseed were grown on the Western plains, where it replaced oats.

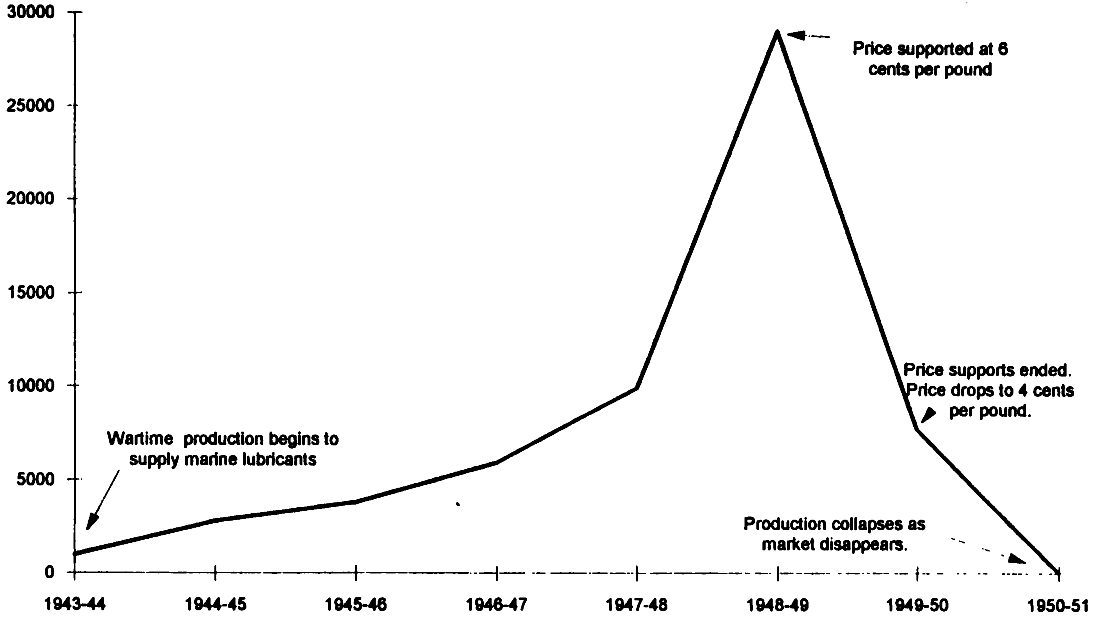
The end of hostilities also meant the end of the market for most of the rapeseed that Canada produced. Farmers, elevator operators, and crushing companies were equally hard hit by the collapse of the rapeseed market with the end of price supports. Within a very short period of time, production virtually ended (see Figure 2).

Yet, Canadians were able to transform this virtually moribund industry into a thriving new one in a relatively short period of time. We take their successes for granted today whenever we purchase canola oil at the local supermarket. Yet, like all scientific undertakings, the development of canola was initially a promise made in response to a vaguely articulated demand. Moreover, it was fraught with difficulties, with unforeseen happenings, with unexpected consequences. In particular, it was hardly enough to transform the crop; at the same time, farmers, processors, shippers, retailers, and consumers had to be transformed.

Act I. The Problem is Defined. The story begins in Ottawa in the mid-1950s in the midst of the Cold War. Canada shared thousands of miles of common borders with the USSR. Dr. Joseph Hulse, a recent Scottish immigrant, was the Director of Food and Nutrition at the Defence Research Medical Laboratory of Canada, a laboratory responsible for provisioning the military. That laboratory was responsible not only for insuring that soldiers had nutritionally adequate rations, but that the nation as a whole had a secure food supply. Hulse also participated in the meetings of the Associate Committee on Fats and Oils of the (Canadian) National Research Council from 1955 to 1961.

The Associate Committee was organized in 1952. Various scientists and representatives from the vegetable oil processing industry met as a group once a year. The

Figure 2. Canola Production (metric tonnes), Prairie Provinces, 1943-50.



Sources: Statistics Canada. Handbook of Agricultural Statistics, 1921-1974; Agriculture Canada. 1991. Handbook of Selected Agricultural Statistics, 1990; Statistics Canada. 1975-1982. Grain Trade of Canada, Annual Report.

meetings of this committee always began with a review of imports, exports, and production of fats and oils. However, linseed oil had been inadvertently included in the list despite the fact that it is inedible. When the linseed oil was removed, it became painfully apparent that Canada was far from self-sufficient in oil production. Moreover, most of the major edible oilcrops of the world could not survive the harsh Canadian winter.

The Fats and Oils Committee was chaired by Dr. Burton Craig of the Prairie Research Laboratory in Saskatoon. Craig suggested that the committee look into the possibilities of using rape as an edible oil.[4] However, rapeseed oil also had some severe disadvantages associated with it. In particular, though it had been used in Germany as an edible oil during World War II, and for millennia in India and China, it was claimed that it had numerous antinutritional properties. Moreover, the rapeseed grown in Canada for use as a lubricant was greenish yellow in color and had a strong mustard-like odor; it required considerable post-harvest treatment to make it palatable. Moreover, rapeseed had not been widely grown in the Western world for hundreds of years. Hence, there was no research literature on which to draw.

These antinutritional aspects of the crop emerged not out of concern for its potential, but out of an attempt to develop new pharmaceutical compounds. Dr. Kenneth Carroll, a biochemist at the University of Western Ontario, had been interested in the properties of various long chain fatty acids including erucic acid. It was already established at the time that rapeseed contained erucic acid, so it was the source of choice for testing. The fact that prairie farmers were also interested in the crop was not a factor in the lab tests. Carroll was quite pleased to find that erucic acid appeared to cause the formation of adrenal cholesterol in mice; for some time it appeared that the acid might be used in a drug for persons with overactive adrenal glands (interview).

In a review article, Beare (1957) had noted that rapeseed oil had been found to have a low coefficient of digestibility that was traced by Carroll (1951, 1959) to erucic acid, one of the several fatty acids that are components of the oil. However, the hydrogenation process (used in margarine manufacture) tended to mitigate these problems. She concluded that "Since information on the metabolism of erucic acid is still lacking[,] the status of RSO [rape seed oil] as a food can be determined only through further experimental work" (Beare, 1957:383). Based on available information, the Committee decided that a project was needed to reduce erucic acid content in the seed.

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[4] Sunflower was also considered. While it can grow under normal conditions in small areas of Alberta, it would have been necessary to harvest it after the first snows had fallen in most of the prairie provinces. Hence, it was rejected. Similarly, the possibility of transforming linseed oil was discussed, but this was considered scientifically impracticable.

Meanwhile, Hulse went to his immediate superior, Dr. Ormand Solandt, then Chair of the Defence Research Board (interview). He convinced Solandt, who had the status equivalent to that of Deputy Minister, to call a meeting of his fellow deputy ministers from Agriculture, Trade, and Health and Welfare. Together they persuaded Agriculture Canada and the National Research Council to develop the necessary research program to eliminate the apparently undesirable compounds from rapeseed.

In short, the decision to pursue making major alterations to rapeseed was based on (1) the lack of alternative domestic sources of edible oils, (2) the dangers of the Cold War, and (3) the desire for food self-sufficiency, and perhaps most importantly, (4) the possibility that the oil had certain anti-nutritional properties which appeared to make it unsuitable for use for human consumption.

Act II. Erucic Acid: The Wicked Stepmother. At first, the problem seemed rather straightforward, easily within the confines of conventional plant breeding. Given the uncertainties associated with erucic acid, it was best to remove it from the seeds. One would employ well-established distillation techniques[5] to the oil from a batch of seeds from a given plant, determining the erucic acid content. Then, the breeder could easily select the plants with the lowest acid content for further breeding.

It soon became clear, however, that changing the composition of rapeseed would involve the invention of new procedures. In particular, since the oil is found in the cotyledon, fatty acid composition of the seed is controlled by the genotype of the embryo rather than the maternal parent. Moreover, two genes, neither dominant over the other, were found to control erucic acid content (Downey and Harvey, 1963; Harvey and Downey, 1964). Hence, each seed from the same plant contained different genetic material and different levels of erucic acid. This had the potential to speed the breeding process by an entire generation. However, since distillation required liters of oil, there was no way to determine the acid content of an individual seed. Moreover, if they did so, they would have destroyed the seed, making the knowledge of its acid content useless.

However, at this point in time a new method for chemical assays had recently been developed by the British scientist, James Martin: gas-liquid chromatography (GLC).

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[5] Distillation involved using the differing boiling points of each fatty acid to identify and separate them. A distillation column would be gradually heated; as each fatty acid boiled, it was removed and separated. Then, it was a simple matter to calculate the proportions of each fatty acid in the oil.

> It [GLC] could analyze a mixture of volatile substances--such as fatty acids in a vegetable oil--by using an inert gas, often helium, to carry the mixture through a tube packed with selectively adsorbent materials. Analysis of the conductivity of the gases leaving the sample tube was then automatically recorded on moving strips of graph paper. Measurement of the areas under the various peaks in the resulting graph gave an accurate picture of the mixture's constituent acids. The graph was a handy visual aid Craig took with him to meetings with farmers. He could show them a picture of what erucic acid looked like compared to other oils (National Research Council of Canada, 1992:35).

This permitted the analysis of very small amounts of gasified chemicals. However, at that time no one had attempted to use GLC for fatty acid analysis. Bill Cook of the CNRC in Ottawa heard of the new apparatus and suggested to Burton Craig, at the CNRC's Prairie Research Laboratory (PRL), that it might be useable in fatty acid analysis. After examining the situation, Craig decided that it was worth purchasing the expensive apparatus for use at the PRL.

Craig soon discovered that the silicon coating of the solids packed in the chromatograph was unsuitable for the analysis of saturated fats. However, he had heard of the newly invented class of compounds known as polyesters and they appeared to have potential. A volume in the local library explained how to produce polyesters and soon Craig was able to produce various different ones to test in his new chromatograph. After some trial and error, he found one that would do the job, reducing the volume of oil needed from several liters to a few grams (Craig and Murty, 1958).

Meanwhile, Keith Downey of Agriculture Canada was trying to figure out how one could have one's cake and eat it too--how the analysis could be accomplished and the seed still be available. Knowing that rapeseed is dicotyledonous, Downey reasoned that if the seed could be cut in half, then one half could be used for the analysis and the other half could be planted if it was found to be low in erucic acid. Using an eye surgeon's scalpel, Downey's graduate student, Bryan Harvey, began to cut the seeds in half, keeping track of the two halves.

Craig was able to refine the analysis techniques to the point where the oil from one half a seed was sufficient for the assay. Then, the other half was grown out into (a usually rather scrawny) plant. Using this technique, it became possible to produce a zero erucic acid variety in several generations. By the time that the French and Dutch laboratories released their findings, raising the distinct possibility that the use of rapeseed oil for human consumption would be prohibited, Downey and Craig had an alternative ready for multiplication by seed companies.

Act III. The Evil Stepsisters: Glucosinolates. While the removal of erucic acid helped to relieve fears that rapeseed oil might be harmful to humans, it did nothing to resolve another problem: It was well-known that the meal was goitrogenic when fed to farm animals in large quantities. When little oil was produced, this was not problematic as the meal could be used as fertilizer. However, when large quantities of oil were produced, the disposal of the meal became problematic. Moreover, given the high value associated with other oilseed meals (e.g., soybeans), the toxicity of rapeseed meal appeared particularly problematic. Until that problem was eliminated, no crusher would use significant quantities of rapeseed meal in animal feed. Growers would be at a significant economic disadvantage relative to growers of other oilseeds.

A PRL team, led by Sallans, worked on this problem. Wetter and Young found that high temperatures during the crushing process triggered an enzyme, myrosinase, to react with glucosinolates, and devised new crushing methods to prevent the destruction of lysine and the release of the enzyme.

At the same time, Downey went around the world to collect seeds with low levels of glucosinolates. He located a cultivar, *Bronowski*, that had levels far below those of other cultivars. By 1972, cooperative field trials began. Agriculture Canada registered the world's first zero-erucic, low-glucosinolate *B. napus* variety of rapeseed, Tower, in 1974. But, the struggle did not end there. The breeders needed to develop a variety of *B. campestris* with low-glucosinolates.[6] Pawlowski successfully crossed two species, *B. napus* and *B. campestris*, and introduced a third species, *B. juncea*. In 1977, a new variety, *Candle*, was licensed as the world's first low-glucosinolate, zero erucic acid (or double zero), *B. campestris* cultivar.

Act IV. Cinderella triumphs (with a little help from the Fairy Godmothers). Moreover, by this time it had also been found that rapeseed--now renamed canola--had certain highly positive properties as well. Most well-known, it had lower levels of saturated fats than any other widely used edible oil. By this time it was well established that saturated fats were implicated in heart disease. Canola's low levels of saturated fats made it particularly attractive to consumers. In addition, it was also desirable from the point of

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[6] B. campestris is suited for somewhat different ecozones than is B. napus. Thus, removal of high glucosinolate varieties required breeding of both species.

Many stories, one narrative. The central theme of the story told above is the transformation of rapeseed into an edible oil known as canola. However, there are other stories that intersect it. First, we have the quest for new sulphur drugs, one that led Kenneth Carroll to examine rapeseed in the 1950s. Second, we have the history of food and drug regulation, of which the rapeseed story forms one among many examples. Third, we have the story of the animal producers who were looking for an alternative feed source; after the removal of the glucosinolates, canola provided just that source. Fourth, we have the history of a scientific instrument, the gas-liquid chromatograph. The modifications made to that instrument in the service of transforming rapeseed also transformed hospital procedures and the entire field of dietary fatty acid analysis. Fifth, we find that the transformation of rapeseed expanded the field of lipid chemistry, giving scientists new insights into the nature of fatty acids. Thus, the story of canola is the story of the intersection of many stories.

Generalizing to other commodities. While certain aspects of the transformation described above are unique to canola, there are nevertheless lessons to be learned with respect to other crops (and perhaps to nonagricultural commodities as well):

1. The transformation required relatively little in the way of new infrastructure. Farmers were able to employ the equipment that they used for wheat planting and harvesting without costly modifications. Existing rail lines and elevators were able to make the switch from oats to canola with little or no added costs. Crushing plants for rapeseed already existed; the transition to canola insured that they would be able to stay in business in the face of a declining market for high acid rapeseed. Food manufacturers were able to incorporate canola into already existing products such as margarine with little new investment.

2. Canola offered significant advantages over other oil sources. Put differently, the elimination of the allegedly antinutritional compounds in the oil did more than merely put the oil on an equal footing with other oils such as soybean, palm, or coconut; it made it superior to these oils from the point of view of a health-conscious public concerned about saturated fat intake.

3. The problems posed and the solutions arrived at required that scientists in different disciplines work together in unusual ways. The collaboration between Downey and

Craig was the most visible of these relationships, but it was essential that animal and human nutritionists, food scientists, and others also work on aspects of the overall project.[7]

4. The Canadian State had the will to make the necessary investments in order to overcome significant obstacles to success. This included changing the rail freight rate structure, creating grading standards for Canola, and investing in research. Indeed, the Canadian government spent 147 times as much (on a crop value basis) to develop canola as the US spent to develop soybeans (Jolliff, 1989). In this sense the development of canola is analogous to the creation of hybrid corn (Berlan and Lewontin, 1986; Fitzgerald, 1990). As is well-known, Henry Wallace, as Secretary of Agriculture, directed that federally-funded corn breeders focus on developing viable hybrids rather than improved varieties, thereby concentrating the entire public research system on the problem. Outside of agriculture, the development of manned space probes involved an analogous process.

5. The allegedly anti-nutritional properties of erucic acid were never documented in human beings. It may well be that each of the findings were species-specific or even variety-specific as was apparently the case with respect to Carroll's rats. However, once the low acid rapeseed replaced other cultivars, there was no longer any interest in studying the effects of erucic acid on human beings, at least not within those nations possessing large scientific communities (Salunkhe, et al., 1992). Thus, the findings and products of plant breeding eclipsed the counter-findings of nutrition studies. As with many other fields of science, in principle we could know whether erucic acid has deleterious effects on people; in practice it is too costly to explore what is now a largely academic question.

6. The extension of the canola network reduced the demand for butter in Canada, although it appears to have had little effect on soybean oil consumption. As Figure 4 illustrates, rapeseed/canola consumption increased dramatically between 1964 and 1986 while butter consumption fell (r = -.89). In contrast, while soybean consumption has leveled off, it is positively correlated with canola consumption (r = .82). Moreover, canola has caused damage to the palm and coconut oil network.[8] These oils are produced in prodigious quantities in developing countries (Malaysia and the Philippines are the largest exporters, respectively) but they are considerably higher in saturated fats than is canola (or

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[7] However, it should be emphasized that there was no one overall project. In that sense, the transformation of rapeseed was only partially planned. Latour cites Machiavelli to show the strategic character of technoscience. However, Machiavelli also talked of the role of fortune in human affairs; we in the social studies of science would do well to heed that aspect of Machiavelli's thought as well.

[8] Canadians are not and have not been major consumers of tropical oils. Soy, canola, and butter are the major fats and oils in use in Canada for the last 25 years.

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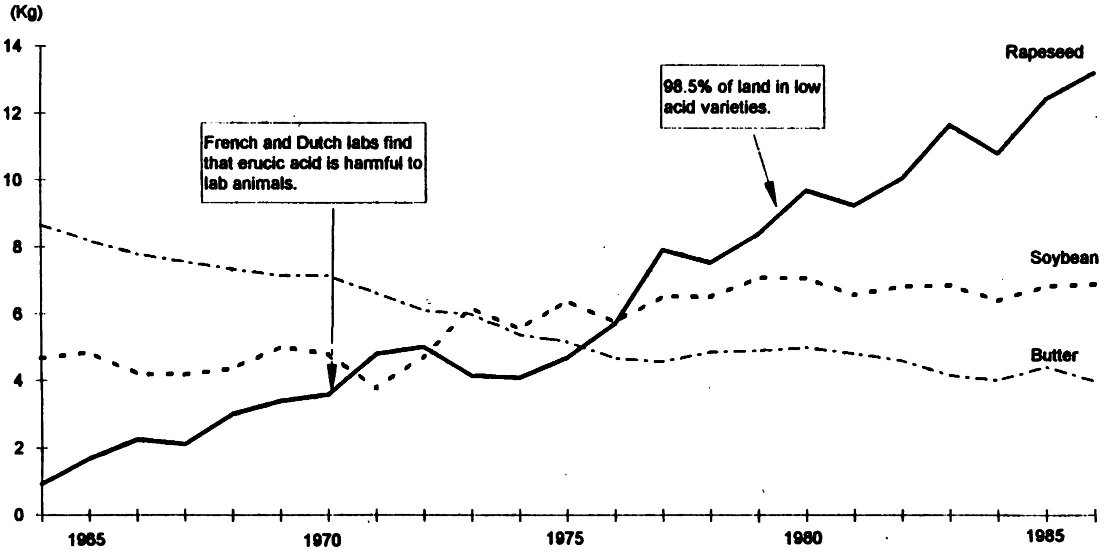
Figure 4. Per Capita Consumption of Selected Fats and Oils in Canada, 1963-1986.



Source: USDA, Foreign Agricultural Circular: World Oilseed Situation and Market Highlights, 1980-1992.

soybeans). As technical data on the relationship between saturated fats and heart disease became public knowledge, demand for those oils in Western nations declined while demand for canola rose. This type of story is not uncommon; consider the effects of the automobile on the harness-making industry.

Extending the networks. The story does not end with the transformation of rapeseed into canola. Change continues on at least two fronts: On the one hand, the area planted to canola worldwide continues to grow. Much of the area in the EC once devoted to rapeseed is now in canola production. Eastern Europe will soon follow suit. In addition, the potential for canola production in the US is now being explored. In particular, farmers in those areas of the US that are adjacent to Canada and share climatic factors are taking advantage of their proximity to Canadian mills to grow the crop.

On the other hand, the same plasticity that made it possible for Downey and Craig to develop the low erucic acid cultivars makes canola a target for other efforts at transformation. Recently, Calgene, a California-based biotechnology company, announced the development of a high lauric acid cultivar (Calgene, 1992). Lauric acid is a central ingredient in soapstocks and is currently unavailable from US sources. Calgene hopes to have farmers grow the new cultivar on contract for use in the domestic soap industry. Other rearrangements of the fatty acid composition of rapeseed to produce other functional attribute (Moshy, 1986) or identity-preserved (Urban, 1991) crops are clearly on the horizon. Such crops are likely to transform the face of agriculture in the more developed nations.

Finally, as a result of both technical change and the current price regimes, the potential of high erucic acid rapeseed as a diesel fuel is being explored. While not economical for general use, economists now believe that farmers can profitably grow enough rapeseed on their farms to power their diesel equipment. If so, then we will have come full circle, producing on the farm the feed for the mechanical horses of today.

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CSSA notes

From: *Agronomy News*, April, 1993. Page 9.

A FAREWELL TO "RELUCTANT REVOLUTIONARIES"

By G. H. Heichel

G.H. Heichel is head of the Department of Agronomy, University of Illinois, Urbana, and Past-President of the Crop Science Society of America. This article is derived from his remarks at the 1992 CSSA Awards Recognition Luncheon in Minneapolis.

An "ethic" is a principle or standard of what is good, right, or moral conduct, behavior, intention, or social action in relation to others. For a scientific society, an "ethic" specifies consideration of the appropriate aims of the society, an evaluation of whom these aims benefit, and an evaluation of whom these aims neglect. On the subject of ethics, crop scientists and other agricultural scientists are a pretty silent group.

Our members have not been conspicuously prominent in the media nor in hearings on Capitol Hill, grappling with allegations of fabrication of data, conflicts of interest, negligence, incompetence, or perjury before an unrelenting newsperson or congressperson.

As a result, many of the problems that have been faced by other scientific societies and organizations have bypassed crop scientists. However, the allegations that scientists and science are "Betrayers of the Truth" [to quote from a 1982 book by W. Broad and N. Wade] have, in the last 10 years, elicited a gratifying response from the scientific community.

Sigma Xi issued "Honor in Science" in 1984 to provide practical advice on ethical issues to persons in science. The National Institutes of Health issued "Guidelines for the Conduct of Research" in 1990 to explicitly prescribe the canons of good science and the responsibilities of investigators and research managers in resolving ethical conflicts. Because it deals with research on human subjects, the American Psychological Association has promulgated "Ethical Principles in the Conduct of Research with Human Participants." As I speak, at least 200 scientific societies and organizations have adopted statements of ethics, credos, or codes of ethics.

Where has the Crop Science Society of America stood in this exchange? Largely on the sidelines, until just recently.

Until the 1992 ASA-CSSA-SSSA meetings, perhaps the most significant statement in our profession on the subject of ethics was made by Boysie Day at a special session during the 1977 annual meetings of the American Society of Agronomy. Dr. Day spoke of the revolutionary role of agricultural scientists in enhancing productivity, claimed that the morality of agronomy is to produce, and acknowledged that the production ethic often conflicts with others of equity, social justice, and politics. As a scientific society, we accepted that *production* was our foremost purpose, or at least first among equal purposes. I return to this point later.

A decade passed. In the meantime, environmental and natural resource issues came to the forefront of societal concerns. When agricultural scientists stepped forward to offer their expertise in the solution of these weighty social issues, we were rebuffed. We are the problem, we were told, not part of the solution. The allegation stung and, for many scientists, the sting has not yet subsided. Agricultural scientists withdrew into their labs and offices and hunkered down.

Revisiting the theme of the appropriate aims of agricultural science in 1987, the eminent agricultural economist V.W. Ruttan observed that "...agricultural scientists...have wanted to revolutionize technology but have preferred to neglect the revoluntionary impact of technology upon society." He wrote of "society's right to hold the science community responsible for the consequences of the technical and institutional changes set in motion by research." Crop scientists, of course, are members of the agricultural science community that Ruttan labeled "reluctant revolutionaries."

After Ruttan's statement, cracks in the wall behind which agricultural scientists had withdrawn became evident. Have you noticed them, even in the Tri-Societies?

At the 1990 annual meetings, CSSA cosponsored a symposium on "Research Ethics, Manuscript Review, and Journal Quality." In 1991, CSSA sponsored a plenary session on "Ethical and Policy Issues in Global Crop Science," and division A-8 held a symposium on "Ethics in Agricultural Consulting." On 2 Nov. 1992, CSSA cosponsored a symposium on "Agricultural Ethics-Issues for the 21st Century." Once it started, the wall of silence weakened rapidly.

In my opinion, the wall of silence on ethical matters behind which crop scientists and agronomists had hunkered for so many years crumbled to ruin on 1 and 2 Nov. 1992. On those days, in independent but complementary actions, the Boards of Directors ratified a statement of ethics for ASA, and for CSSA. The ASA and CSSA now have a statement of guiding principles which represents the basic scientific and professional values of our profession.

The statement was published in *Crop Science* 32:1520(1992) and contains six points. The fourth point rescinds Dr. Day's 1977 position that it is morally just for agricultural scientists to engage in "production research" without attending to the social consequences of their research. It affirms Dr. Ruttan's assertion that we must agree to be held accountable for the effects of our revolutionary science upon society.

Crop scientists will "Demonstrate social responsibility in scientific and professional practice, by considering whom their scientific and professional activities benefit and whom they neglect."

This responsibility is not more obvious than in the imperative to consider the external costs flowing from the pursuit of a productive agriculture that society does not view or value as benefits: environmental problems, social inequities, geopolitical inequities, fraud and misrepresentation, conspicuous mistakes.

Why have external costs been omitted from the calculation of the benefits of "production" and "productivity"? Sometimes external costs were omitted because we did not have a convenient way to measure them, because we did not have to bear them, or because they were beyond our realm of comprehension. We can no longer invoke these disclaimers. Our knowledge of external costs increases daily. We can measure them. We can comprehend them. And we pay for them.

I urge you to affirm this statement of ethics and to implement it in your personal research and education programs. I urge you to give it life, incorporate it into curricula, and exemplify its principles in mentoring the next generation of students, as well as the current generation of citizens and public policymakers.

In closing, I want to convey my great appreciation to CSSA members for allowing me to serve as president and to learn from you and the fine officers that it was my privilege to join. I believe that I have witnessed a transformation of CSSA members in the last two years. You have evolved from being "reluctant revolutionaries" to adventurous leaders in discussions of the ethical and social impacts of agricultural science. Welcome to your new role!

Mr. **Jolliff**. Thank you.

I would just make a footnote here, that there is a prepublication manuscript about socializing nature, by Dr. Larry Bush from Michigan State University, who is a rural sociologist, and it is entitled "Socializing Nature: Technoscience and the Transformation of Rapeseed into Canola." I draw your attention to it because it shows the history of the development and commercialization process that we know now as a world class success, and it shows the complexities involved. I think it shows the kinds of roles that the AARC Center can play. And I think we all realize that every situation will be different. The AARC is set up so it has the freedom to have that flexibility, and that is exciting for reasons that Dr. O'Connell mentioned earlier. I submit that prepublication manuscript as one of the three exhibits.

There is a second exhibit, and it is not intended to reflect on the Board. It is entitled "Organization and Systematic Distortion of Information." I think it is something we need to be aware of that occurs in our society. We need to be sure and make provisions before it is too late.

The third exhibit is comments of the president of my professional society, calling us to a standard of ethics, remembering the people we do not serve, at the same time we remember the people that we serve. That is the essence of my remarks today. My written testimony will back this up. I hope that this input will be viewed in a positive way.

For the record, Mr. Chairman, I would like to state and emphasize my very strong support for the concept of the AARC Center. My written testimony includes statements for justification of this institutional innovation that we now call AARC.

With regard to the AARC Center funding justification that Senator Harkin mentioned, the $25 million for next year, I would just say that in my written testimony, I did some calculations on the total cost to the Nation resulting from us not using to the full extent this agricultural production capacity. To show the potential for AARC, I added the cost of the cash outlays from the USDA budget, Function 351 plus certificates, and I calculated an average value of $159 per acre for that idle land that is not producing something of value.

I used a conservative multiplier of 2.0 for the loss in economic activity from the lack of that renewable wealth coming off of that land. I also added five percent simple interest for the money borrowed in the Government to pay the outlays. And in the decade of 1982 through 1991, with those conservative figures, the total exceeds $550 billion.

Now, if I symbolically extend that to 15 years, the period which I have been working on a new crop as an alternative to give farmers something that is profitable, and increase the multiplier to 2.75, which many economists say is entirely legitimate, that figure totals $770 billion.

I am not an economist and I am sure that there are a thousand ways to calculate that, but the point is that, as you gentlemen go to your colleagues to gain support for the AARC Center, if you go back and do some of these figures, I think we can see that the AARC Center has a chance to really make a contribution to the national well-being, and I strongly support you in your efforts to do that.

Further, I commend you, Mr. Chairman, especially Senator Conrad, as well, and the other colleagues, Senator Harkin, you folks I think are doing a marvelous job in taking the risk to come out and get this new entity created, organized and active.

In my written testimony, I took the liberty to describe why I believe the AARC Center has such a tremendous opportunity to contribute to the prosperity of our Nation. I have provided narratives, with references, to share the vision I have for the AARC Center, and there isn't time to go into that. The noncapital outlay influences the AARC Center Board of Directors can have are tremendous. There is no end to it.

As I stated in my written testimony, I think the AARC Center Board is the vehicle to start a megatrend for the kind of thing that Senator Harkin referred to. I have referred to Joel Barker, a recent innovator, who explains paradigms and the way we think about things. The AARC Center Board of Directors ought to be a facilitator of paradigm engineering.

So with all of that, it is difficult for me to share my honest thoughts today about what I believe needs to be done to improve the AARC Center. I trust that you and the AARC Center Board will receive my recommendation as a constructive critique.

My assignment, Mr. Chairman, according to your request, has been to examine the published information from the subcommittee provided to me on the activities of the AARC Center Board of Directors since their appointment with respect to the AARC Act of 1990.

In general, I found evidence of good progress in the moving of the AARC Center activities forward. They seem to be following most of the letter of the act. There is one general area which may have substantial room for enhanced activity. I will summarize that area of concern in a moment. Additional details are covered in the written materials provided to the subcommittee.

Relative to the AARC Center Strategic Plan, A Living Document that was referred to—it seems like a good publication for communicating to the public. I believe it is important to have this type of material to clarify to outsiders the thinking of the AARC Center Board of Directors.

I have one major concern and it relates to the processes involved in making decisions at the Board of Directors level. The concern is not the result of discovering any obvious problem. Rather, the concern is the result of not discovering evidence of certain kinds of activities.

For example, I found no evidence that the advisory council [which is] called for in section 1661(c) of the act had been consulted, as called for in section 1659(b)(2), or that the advisory council had even been appointed. This draws attention to how decisions are made and how open the decision process is to public scrutiny.

In written materials, I provide the subcommittee more than 20 citations, quotations, references and exhibits as rationale for recommending the development of an accountability mechanism for the decisionmaking process used by the AARC Center Board of Directors.

In my opinion, there is strong evidence to suggest that special efforts need to be made by the Board of Directors to open their decision-making process to the continuous "light of day" and scrutiny by professionals who have the best interest of society-at-large as part of their professional expertise.

I believe that society-at-large is asking all of agricultural science and technology to change the way it does business. The AARC Center Board of Directors needs to be a leader in demonstrating and sharing with the public high ethical standards in the way it does business. This, in my opinion, should not be left to chance.

The AARC Center is truly an institutional innovation. It represents a new way of doing things. It is a new set of rules for doing business. That new set of rules is deemed essential to get the needed job done.

Similarly, it seems that there is now a critical need for innovation in developing an accountability system to be constructive and to assure that the AARC Center Board activities also meet the letter in section 1659(c) and the spirit of the AARC Act of 1990 over the long term. I think this is somewhat like you gentlemen representing the people of the United States looking at policy and overall direction, and you leave the technical things up to someone else, but your activities, such as this hearing today, are open to the public. I am not suggesting I know the exact answer, but I think innovation needs to be looked at in this area.

Fuglie and Ruttan published a paper on the value of external review of research at the International Agricultural Research Institutes. I recognize that they are different than the AARC Center, so I am not trying to say it is the same thing. But these authors emphasize that external reviews cannot be "a substitute for an institute's internal strategic planning capability or capacity."

This is another example from the literature which causes me to believe that the decision-making process used by the AARC Center Board of Directors, including deliberations on policy, should include at least one rural sociologist and one ethicist having expertise relative to the family farm and rural America.

It is recommended that the system be put into place soon. Details of an appropriate system would need to be developed. The AARC Center Board of Directors may have part of this system in place. If it does, the tactics need to be specified and provided to the subcommittee and others who have oversight responsibilities.

Further, it seems essential that all persons influencing AARC Center policies and funding decisions be held accountable for their input. The specifics of the accountability system might vary, depending on the role played by each person. However, if a good system is put into place first for the Board of Directors, development of the remainder of the system for other parts of the AARC Center should be easier.

Mr. Chairman, in the interest of time, I will draw this segment to a close and offer to provide more input or clarification in areas which you might find most helpful.

Thanks again for this opportunity to participate.

Senator DASCHLE. Thank you, Dr. Jolliff. I think you have made some very good points, and I think you have done so in a constructive way. We are just getting organized here. We want to do as good a job as we can in making sure that we follow through with our responsibilities and with the expectations for what can be done.

Because you raised such an important issue, let me just ask Dr. O'Connell if he wishes to comment. There are three questions that I have. First, what is the status of the advisory council?

Mr. O'Connell. First of all, we felt the initial thing we wanted to do, we had the hearings, and to get going and to get projects out there. We put our emphasis on getting something done, something tangible. That is not to say that what Dr. Jolliff said here is not important.

We feel that the advisory council and the regional centers kind of will tie together. The regional centers, which we will be setting up this year two of them and then more of them in the following time period, will be a totally open process, and then they will be developing information, making recommendations to the Board of which projects have merit.

Setting up the advisory council is a very time-consuming activity and so we made a choice, the Board made a choice, should we put our time on that or should we get the initial projects out. I agree with what Dr. Jolliff said, and the way we handled the advisory council, quite frankly, which is basically doing the same thing. The main thing the advisory council was supposed to do was review the proposed projects.

We had 70 outside reviewers that we had review the 400 pre-proposals, which basically was the primary assignment of the advisory council. But setting that up in a formal manner can take anywhere from six to nine months in the Department. It is just a fact.

So rather than setting up a formal advisory council, we had these outside reviewers, which more likely would be on the advisory council, anyway, to handle it that way, and those are a matter of public record. In fact, anyone that put in a proposal and felt they weren't treated fairly, we sent them back the comments of those reviewers on their proposals, and that is a completely open— we don't indicate who they are, because that is just simply not appropriate.

So the advisory council responsibilities were handled by these 70 outside reviewers that used that other aspect of it. So we intend to implement the advisory council, but we just wanted to put our emphasis on getting the initial projects out and we will.

Senator Daschle. What is your time frame for implementation?

Mr. O'Connell. I would say the next round of projects that we have, I would say three or four months, five months. It all depends on how long it is going to take within the Department. But that is the reason we didn't do it. We wanted to put our emphasis on getting initial projects funded.

Another aspect of it was to do both the advisory council and regional centers kind of together.

Senator Daschle. To what extent are you taking the advice that Dr. Jolliff had emphasized about the need for public accountability and public scrutiny? You referred to the fact that all this was public. I assume that the meetings are public and that there is a good deal of public scrutiny given to all of your deliberations and decisions.

Mr. O'Connell. When the Board reviews the actual final proposals, it would be inappropriate for us—and this is done on advice of counsel in the Department—when they narrow the projects down from the 400 down to 48, that simply has to be done by the Board. That can't be done with the particular interest parties doing that. It simply has to be done by the Board, or otherwise it just wouldn't work.

Also, when they actually selected from the 48 and selected the 20, that had to be done, too, just by the Board, for obvious reason. You couldn't do that. But any other aspect of the Board's activities are completely open. But when you actually select the projects, that has to be done behind closed doors.

Senator Daschle. I understand. Thank you. We will follow up more, I am sure.

Mr. Jeff Gain, as I said, is the Chairman of the New Uses Council, and Chief Executive Officer of the National Corn Growers.

Mr. Gain, we are delighted to hear from you.

STATEMENT OF JEFF GAIN, CHAIRMAN, NEW USES COUNCIL, AND CHIEF EXECUTIVE OFFICER, NATIONAL CORN GROWERS ASSOCIATION, ST. LOUIS, MO

Mr. Gain. Mr. Chairman and distinguished members, thank you for the opportunity. Paul, not to be outdone, I pulled my briefcase over here. I am not going to do any demonstrations, but I may show you a few things in my bag of tricks.

Mr. O'Connell. You couldn't stand it, could you.

Mr. Gain. This is not all just corn, either. [Laughter.]

I must say at the outset here, I want to thank one of the members of this distinguished group this morning, particularly, Senator Conrad. He received our Wheeler McMillan Award, Frontiersman in Agriculture, for his leadership in getting this in the farm bill.

The New Uses Council is a nonprofit organization officially established in 1990 by individuals involved in agriculture, manufacturing, government, technology development and scientific research. These individuals believed that America's vast agricultural resources were underutilized and that new economic opportunities and environmental benefits could be gained through the use of these resources in the production of environmentally friendly industrial and consumer products.

I might also add that the New Uses Council is also the advocacy group for this whole movement, and we serve as kind of the watchdog for AARC. We are well aware of the procedures that they are and aren't following and are comfortable with the way it is being operated. One of our main challenges is to make sure that the intent of the law and the program is operated the way that it was intended.

Unfortunately, the story of industrial uses of renewable agricultural resource is one of America's best kept secrets. As you know, Mr. Chairman, many years ago, people like Henry Ford, Thomas Edison and Wheeler McMillan attempted to develop industrial markets for renewable resources. They failed, because there was no economic incentive for industry to use renewable resources. Petroleum, as an industrial feedstock, was cheaper and domestically plentiful. Environmental damage was not a consideration at that time.

However, as you know, the economics of renewable resources are changing. The price of a barrel of oil is still relatively low, but environmental damage, lost jobs and economic opportunities, and the threat to national economic security caused by ever higher oil imports must now be considered. Also to be considered is the cost of idling 60 million acres of cropland each year, rather than using that land to produce renewable resources for industrial markets, which has been alluded to earlier today.

Also contributing to the improving economics of renewable resource-based products is technology. Advances in biotechnology and material processing techniques hold great promise for developing new materials and reducing the cost of converting renewable resources to industrial products. The AARC Center will fund several exciting new technologies that could have a dramatic effect on the economics of renewable resource-based products.

The public is generally unaware of the fact that many of the products and materials currently made from nonrenewable resources, particularly petroleum, could be made from environmentally friendly, renewable agricultural resources. I would venture to guess that the farm community and rural America are also largely unaware of this fact.

The New Uses Council will take the story of "new uses" to the countryside. The council is now preparing and will soon launch a nationwide effort to build public awareness of the uses and benefits of using renewable agricultural resources for industrial purposes. In our effort to generate public demand for renewable resource-based products, we will be highlighting the true cost of petroleum-based manufacturing.

The New Uses Council will strongly support Federal programs and policies that encourage the development and commercialization of new renewable resource-based industrial products and materials. The council strongly supports the AARC Center program and feels that it is working well. Its funding should be increased as rapidly as possible. The six regional centers that Paul talked about should be established before the end of this year, if possible.

I recently read in the Washington Post that the Clinton administration is exploring a joint project with the Big Three auto makers to build a "green" car. The article mentioned that up to $1 billion in Federal research money could be focused on such a project.

Let me suggest to you that a similar project should be launched to develop a whole new generation of "green" industrial and consumer products made from renewable agricultural resources. AARC has $10 million. Think of the impact of focusing $1 billion on product development and commercialization efforts.

I would like to remind you, too, that there are three of us here this morning that served on the new Farm and Forest Task Force, which really generated this whole AARC concept, and the initial recommendation of that report was for a billion-dollar fund to be established as a revolving fund in perpetuity to allow these things to continue to replace the resources, as successful products were generated, and I think that concept needs to be reexamined.

In conjunction with such a project, a national renewable resource development policy should be developed. The goals of such a policy could be to reduce demand for imported nonrenewable resources, create jobs and economic opportunity for Americans, particularly rural Americans, secure net environmental benefits for the Nation, and expand market opportunities for American agriculture.

The council understands that developing and implementing such a policy will take time and strong support from the public. It will assist in this effort in every way that it can. In the meantime, greater coordination of renewable resource development activities is needed among Federal agencies and departments. The council suggests that a Cabinet or sub-Cabinet coordinating group be formed to insure that resources and programs are working together, not duplicating one another or working at cross purposes.

To help facilitate this effort, the council suggests that the Office of Technology Assessment conduct a review of USDA, DOE, Commerce, DOD and EPA activities, to determine if and how those activities could be better coordinated and implemented to accelerate the development and commercialization of industrial renewable resource-based products.

If you will look just at the surface quickly, you will find that there are many opportunities for overlap and a lot of opportunities for coordination of these efforts.

The New Uses Council will help build a network of individuals and organizations, both public and private, interested and involved in developing and commercializing new industrial products made from renewable agricultural resources. This will be done through the council's quarterly publication, workshops, conferences and the Bio-based Products EXPO scheduled for January 1994 in Kansas City.

Finally, the council will work with rural development agencies, the Small Business Administration and others to encourage the establishment of value-added businesses in rural communities.

With us this morning is an individual who is an initial member of the AARC Board, Mark Dungan, when he was on Secretary Madigan's staff. Mark is now the president and CEO of the New Uses Council, and he is going to be giving leadership to the expanded role of the New Uses Council down the road.

It is the value adding aspect of industrial products that will generate the most new jobs and income for rural America.

In conclusion, Mr. Chairman, I want to commend you and your colleagues for your vision and leadership in the area of industrial market development. Your support of the AARC Center and its funding has been invaluable. In this time of severe fiscal restraint, starting and funding a new program is no small feat. The council salutes you and promises its continued support of your efforts to move this program along, which means economic hope for so many, and environmental relief for all.

Thank you for the opportunity to speak on behalf of the New Uses Council, and I would be happy to answer any questions you have.

Just as kind of a parting shot here, Paul, let me quickly show you some of the really exciting things. This is a Q-tip, biodegradable. This is one a couple of the utensils that are designed for composting in fast-food outlets. This is encapsulation of atrizene and the starch-based product here from corn. It has many environmental implications.

This is the hydrosorb, absorbs over 1,200 times its own weight in moisture, and can be used for cleaning up spills, baby diapers, all kinds of things.

Senator DASCHLE. What is it made from?

Mr. GAIN. It's corn starch based.

This is a ballpoint pen. This is a disposable razor. These are the packing peanuts. This is a dog bone. This is a deicer. This is petroleum-based, but it can be made more economically. The technology is under intensive review at the moment from a corn-based product or other sources of acetate. These are golf tees.

This is an interesting one. This is a guide for a needle in surgical procedures. It gives you an idea, Paul, of the kind of diversity of application, but they had a problem with needles not being cleaned after they were used and the needle guides. People were reusing them. Now they are made out of this degradable material, so if you try to clean it, it dissolves and it has a contribution to make in terms of the safety of medical procedures.

Paul and I have a running debate on. This one happens to be based with corn starch, but it is a clay pigeon and it has got some corn starch and some sand, about 12 percent starch and the rest of it is sand and a little bit of corn oil. You think this is not really a very big thing, but it is another example of a very big diversification in agriculture and the tremendous range of opportunities. Over 500 million of these are sold annually in the United States every year. This is very friendly to the environment. The ones that are made out of clay are toxic to hogs or livestock, you know, and have some environmental concerns associated with them. This one just goes right back in the environment.

Mr. O'CONNELL. You didn't finish the story. What do they make it out of now?

Mr. GAIN. I'm not going to tell, Paul.

Mr. O'CONNELL. Maybe wheat starch. The corn holds it together too well. [Laughter.]

Mr. GAIN. I would just conclude by making official note of the fact that I am wearing the National Corn Growers Association hat, as well, and we as an organization have been dedicated to this movement. With all due respect, we don't really care which farmer gets what product sold, as long as there is a new product, as long as it rebuilds rural America, and that is our concern.

Thank you for the opportunity.

Senator DASCHLE. Thank you. That is certainly the right attitude, and I guess it is shared by many of us on the committee, as well. We don't care, either, but I think that new market development is critical.

I really like the idea of an OTA review. I just talked to Senator Conrad, and we are going to talk a little bit more about that kind of a review. I think there is a lot to be said for that, especially right now.

Mr. GAIN. It seems to fit real well with some of the new administration's goals and a much broader context, as well.

Senator DASCHLE. Exactly. It is the beginning of a new Congress and this is really a good time for something like that, so we may be back in touch with you on that.

Mr. GAIN. We would be happy to work with you.

Senator DASCHLE. Very good.

Senator DASCHLE. Mark Carver is our next witness, the vice president and general manager of Arkenol.

Mr. Carver, we are pleased you are here and invite you to proceed.

STATEMENT OF MARK CARVER, GENERAL MANAGER, ARKENOL, INC., LAGUNA HILLS, CA

Mr. CARVER. Thank you.

I am pleased to have the opportunity to appear before you today to present how Arkenol's project, assisted by AARC's resources, will benefit the market diversity needs of the U.S. agricultural community.

Additionally, it is particularly gratifying to be addressing you, Senator Daschle, given your long-standing support and commitment for ethanol and alternative fuels. Although I have not had the pleasure of meeting you prior to this, I feel like I know you through our involvement in the Clean Fuels Development Coalition.

Briefly, our project is the commercial demonstration of a process to convert biomass to ethanol. Arkenol is modifying a conventional grain-to-ethanol facility in Forth Worth, Texas to one that utilizes our proprietary form of concentrated acid hydrolysis. The facility will initially produce 18 million gallons of grain ethanol annually, which will be replaced incrementally by the Arkenol process. This process will convert agricultural products and residues (sweet sorghum bagasse, Johnson grass, switchgrass, milo straw, corn stover, et cetera), waste papers and woods to sugars which are then conveniently and conventionally fermented and distilled into ethanol.

We believe that we have learned enough about the technology through lab- and pilot-scale testing, that it is now time to take the next step and build a full-scale facility, so we may learn to demonstrate the process on an integrated commercial basis. In addition to grain ethanol, initial ethanol production from biomass will be 3.5 million gallons annually that will be quickly expanded to 15 million gallons, once the process is optimized for long-term commercial profitability.

Our expected in-service date is February of 1994, not too far away. All in, the project is expected to cost $45 million, of which Arkenol and its partner are committing $9 million in cash equity. As an immediate follow-on to the successful demonstration of the technology at this site is Arkenol's development of a rice straw-to-ethanol facility near Sacramento, California, which will be 15 million gallons of production.

The participation of AARC in this project has been very helpful in several ways. First, the fact that an arm of the USDA has independently reviewed our technology and development strategy and found it appropriate to invest with us gives our effort credibility in the eyes of vendors, suppliers, State and local agencies, and the financial community.

Second, the funds to be provided will assist in our meeting the capital structure requirements to obtain our project financing. It is clear from conversations with lenders so far that the presence of the USDA in the project carries certain weight. Lastly, and probably the most important, a relationship with AARC is giving us information about and a network into the agricultural markets that will serve us, as we expand our business into other areas of the country.

The project impacts will be several on the agricultural industry and rural communities, and let me list just a few. One will be increased crop utilization. Many crops have biomass residues that can now be turned into marketable products. This is becoming even more important, as communities begin to restrict the field burning of stubble and new farming practices suggest that stubble not be plowed under. For example, using the corn stover and cobs, one can now produce two and a half times the amount of ethanol from the same acre as from corn alone. This means that for the same inputs and an incremental cost for gathering and transportation, the farmer can realize additional income from the same acre.

Second will be the market for new crops. Crops grown specifically for their biomass content, instead of their food content, will provide the farmer additional market choices. These new markets will also lead to the utilization of new agricultural technology developed through USDA and university programs.

Third is erosion control. Many of the crops that produce appropriate biomass can be grown without tilling the soil thereby improving the soil over the long run. Additionally, since a lot of marginal production land can sustain the growth of perennial grasses and other nontillable crops, the USDA could reduce its set-aside program funding, as a farmer could now realize income from such crops without harming the land or impacting price support systems for food crops.

Fourth is job development. The placement of such facilities needs to be in close proximity to its feedstocks. As biomass is much more problematical to handle and transport than grain, a rule of thumb is that a 50-mile radius is a maximum. Therefore, additional job development will necessarily come to rural areas. Significantly, Arkenol's process is not confined to the grain belt. Biomass crops can be grown in many parts of the country. Due to the needs of the ethanol market, much of the new production activity might be placed throughout the Southeast and the Northeast, close to the refining community.

Another project impact is a stronger political base. The provision of additional agriculturally related jobs and tax base and the increased participation in the production of domestic renewable fuel sources give the agricultural sector of our country and our economy an additional purpose for being. Programs such as these would encourage young talent to stay with the farming industry.

AARC Center programs: As this is a commercial project, there is a high likelihood that the funds invested will be repaid to AARC at a reasonable yield. The revolving nature of the funds and the knowledge gained in the relationship will serve AARC to assist other companies in their efforts to commercialize appropriately related technologies.

Additional impacts not directly related to the agricultural industry will be the ability of this technology and others like it to reduce our dependence on foreign oil and oxygenate sources, and be an additional market for the "recycling" of paper and wood products, thereby reducing landfill space needs, et cetera.

While there are many areas in which AARC might be of assistance to companies such as ours, I would like to focus on just two.

First, even though it is peripheral to AARC's scope, a stable ethanol market has to be present before the production of ethanol from biomass can experience a rapid capacity expansion. The financial community will not participate in providing capital to biomass facilities, if there is price and volume uncertainty in the market for its main product. It is great to make technology advances, as Arkenol has. However, it is of no purpose, unless there is a marketplace.

The recent events surrounding EPA's reformulated gasoline ruling are not conducive to such a stable market. There must be a place for ethanol under the Clean Air Act Amendments as they pertain to transportation fuels. The few limitations ethanol is subject to as a fuel are related to evaporative emissions, and I am pleased to see legislation introduced by Senator Daschle, S. 465, to expand the use of ETBE being considered. It is interesting to note that this bill is also supported by a wide range of both ethanol and oil company interests. Support for this bill and other efforts is vital to the American farmer, if this market segment is to have a chance to grow.

Second, a new understanding needs to be present in the agricultural community that economical biomass conversion technologies put them into the position of being a major feedstock supplier to a new industry, the production of specialty and commodity chemicals via the fermentation of sugars. Many marketable products other than ethanol can be made from these inexpensive sugars.

The eventual success of this new industry, and the agricultural community's participation in it, depend on the community's ability to supply reasonably priced biomass crops that are not necessarily related to food crops. This will take significant research, experimentation and training of farmers.

For example, much good work has gone into obtaining increased grain yields from grain sorghum. A similar effort needs to be undertaken to obtain the maximum biomass yield for sorghum and other similar crops. Related efforts would be those to determine which large biomass crops use the least water, process CO_2 efficiently, et cetera.

Other feedstock-related issues for study and implementation are biomass harvesting and delivery systems, the use of soil bank funds to finance the growth of crops on set-aside land, et cetera. Each of these areas have a direct effect on the ability of Arkenol and others like it to expand its business to the benefit of the agricultural community.

Thank you for letting me testify.

Senator DASCHLE. Thank you very much for an excellent statement, Mr. Carver. We are very pleased to have you here and to have the benefit of your expertise.

I have a number of questions, but I think I am going to go on and finish the panel, if I can.

Mr. Michael Riebel is executive vice president of Phenix Composites, in Mankato. We are delighted you are here, as well.

STATEMENT OF MICHAEL J. RIEBEL, EXECUTIVE VICE PRESIDENT, PHENIX COMPOSITES, MANKATO, MN

Mr. RIEBEL. Thank you.

I am pleased to appear here in front of the Senate subcommittee hearing on the AARC, and I also personally would like to thank everyone for the opportunity to talk about a very revolutionary technology that we are working with with AARC.

My name is Mike Riebel. I have grown up in rural Minnesota and went through 4-H, FFA and through the whole rural area, and also went through all the high-tech of the universities and business training, so I got a real interesting view of how everything works from both agricultural on the industrial and the university side.

I don't have the fancy demonstration that Paul has, but I do have some visuals.

What Phenix Composites has developed here and will manufacture is a unique agriculturally biobased composite technology. The product I am showing there is called NewStone. NewStone is basically derived from soybean proteins, basically the soybean meal after the oil is extracted, and it also has waste paper in it. It is a composite reinforced structure. About 50 percent of the board you are holding is soybeans.

Senator DASCHLE. You say 50 percent?

Mr. RIEBEL. 50 percent of what you are holding is soybeans, about 40 percent is waste paper, and 10 percent is other products that are put in there, all nontoxic and all biobased.

This is the first product of this new technology, in which we see an immense amount of technologies, products and materials that will traverse a wide range of markets in the future. The piece that you are holding basically works exactly like wood and can replace virtually all hardwood applications in markets. You can mill it, you can screw it, you can nail it, it can be glued together with wood and be made into furniture, millwork and virtually any applicable where wood is used, either structural or decorative.

Senator DASCHLE. Do you know what its durability is? Have you been able to test the product's durability at this point?

Mr. RIEBEL. Yes, we have done an exhaustive amount of testing on it, and we can engineer this material to meet the needs of the market, which is very unique. When you get a tree, it kind of gives you its characteristics by its nature. But we can truly engineer this material to meet the wide range of needs.

This breakthrough in bioengineering represents a whole new industry for the United States, and a whole new market for agricultural products. Multitudes of products expanding to construction buildings, furniture, structural material and other uses are only limited by the time it takes to engineer these new composites.

Our company has a vision to move this technology forward and is fully committed to this task, and by the development of these plants we plan on working with, we will provide economic development, job creation, increased tax base and a solution to waste disposal and environmental issues.

As I stated before, the material we use is about 50 percent soybeans. Fifty-five pounds of paper and 1 bushel of beans equals about 22 board-feet, which would do an average desk. I quickly calculated that this table here is about an acre of Minnesota soybeans, and so probably this building would keep our region going pretty good for a while. [Laughter.]

Our goal at Mankato and what we have done to date is developed a pilot plant operation basically to seed markets and to supply expert engineering information to develop full-scale production plants. Even our small pilot plant will exceed 11 million pounds of soybean flour for the Mankato area alone, and only be able to supply just seed markets. We won't be able to satisfy any markets that we have approached so far.

We have contacted one window manufacturer in Minnesota, well-known in the United States, and their estimate is that they could use our material for 10 percent of their needs. We would take five percent of Minnesota's total soybean production for one company in Minnesota.

We have talked to the largest office furniture manufacturer in the United States. If we would use that, we would have to put up joint venture factories throughout the Midwest to be able to serve their need.

We have approached a wide range of markets, both national and international and have had wonderful success with it, because of the natural look of granite, or we can make it look like wood and then it's high value added.

The value-added aspect is important and we have had a wonderful opportunity to work with the United Soybean Board. They have been one of the initial funders, along with ourselves, to move this project forward. We received a quarter-million grant for basically helping the research along to get the pilot plant going.

Also, we have been finding out on the market that the environmental concerns of the market, both from the trees and also because of the waste paper make this an ideal product where we see a merger of agriculture, the environment and high technology together for the first time.

I would like to talk a little bit about AARC. The AARC loan we are going to be getting is essential to our commercialization of this product and process. Basically, we will be setting up starting next week a new facility which will be used for the commercialization and the full-stream production of this material to be shipped to initial markets.

We have put in over $1 million of private financing. The United Soybean Board has put in financing and is also considering additional financing, along with AARC.

Based on this experience, we are totally convinced that this will be an outstanding investment on the Federal Government and I hope we will be used as a good project here for the first round of

AARC, along with these other fine projects, to show what good that these uses can be.

Before we talked about nonfood agricultural usage, and one of the biggest usage in the history of agriculture was with the soybean. From 1910 to 1960, virtually all plywood was made from the soybean. That was taken away by the petroleum industry and with formaldehyde and hydrocarbon-based glues back in 1960. This market represented one of the largest uses for soybeans from that period of time. I remember talking to the processers in the Mankato area. They clearly remember train carloads of soybeans going out to the west coast for this use.

This kind of composite technology hopefully will revive and even accelerate that kind of usage, because of the wide range of markets.

I would like to thank Dr. Paul O'Connell and the people here at the AARC Board. I think people like Paul O'Connell can be very highly recommended. He really understands the needs of industry, the needs of business and the need to keep the bureaucracy out of programs like this.

I would like to commend the composition of the Board. I think it was wise to move to business people and to keep the bureaucrats out. I think the Board can review and understand our needs and move forward with the pace that small companies like us require.

I strongly disagree with Dr. Jolliff on different issues of peer review. I think if we get to this point, we have the technology in hand. I think the review of people like yourself on the Board to make sure that it is a proper business decision and a marketing decision is sufficient oversight.

I agree with commercialization. I think that our company has been very successful, because we have looked at agriculture not only from a research point, but we have also looked at it from a market and commercialization point and pushed the technology to meet the market needs.

I would like to thank everyone for their time and for their help. I would like to answer any questions at this time.

[The prepared statement of Mr. Riebel follows:]

Prepared Statement of Mike Riebel, Executive Vice President, Phenix Composites, Mankato, MN

THE PURPOSE

Phenix Composites, Incorporated has been selected to receive a million dollar loan under the Alternative Agricultural Research and Commercialization program (AARC) to assist in the accelerated commercialization of a revolutionary new building product, NewStone, based on soybean flour and waste paper. I am pleased to appear before this subcommittee and to detail the positive impact of this award, delivered in a timely basis with no bureaucratic hangups.

THE COMPANY

Phenix Composites, Inc. (PC) is located in rural southern Minnesota, three miles south of Mankato on Highway 22. Phenix Composites, Inc. was incorporated in June 1992 for the purpose of structuring the development and commercialization of NewStone and related products and processes in Minnesota.

Phenix Composites, Inc. formed a subsidiary, Phenix Composites International to focus on joint venture relations and international licensing. These areas will receive a high degree of concentrated effort by management due to the huge markets accessed through joint ventures and licensing and to anticipated increased demand for U.S. wood products.

Phenix Composites, Inc. filed a utility patent application in the United States in June 1992 to protect its process and product. Currently, the patent is in an "applied for" status. NewStone is also registered under the reciprocal international patent agreement in a number of foreign countries. The name NewStone is a registered trademark.

Phenix Composites, Inc. works closely with Mankato State University's College of Physics, Engineering and Technology for advanced testing and draws upon the expertise of faculty and students and other consultants.

THE PRODUCT

Phenix Composites, Inc. has developed and will manufacture a unique composite material called NewStone 100 (called NewStone throughout this document). The material is manufactured using a unique monolithic resin from soybean flour and other chemicals, blended with cellulose waste paper recycled from newspapers and color additives. NewStone is a cost-effective composite similar in appearance to granite, but with the characteristics of wood.

NewStone's ability to work like wood and maintain the solid surface granite look throughout the material gives it tremendous product potential in virtually all traditional hardwood product markets. NewStone is four times harder than oak; has good degrees of strength and elasticity; and is available in a wide variety of shapes, sizes and colors. Initially, NewStone will be available in sheet stock and long board stock.

NewStone can be screwed, sawed, milled, routed, drilled and worked with traditional woodworking tools. NewStone can be glued together with standard wood glues and standard construction adhesives. It also can be glued and joined together with traditional woods, unlike other solid surface hydrocarbon-based, plastic materials, or real stone. This unique look of NewStone and wood offers additional flexibility to the builder and designer.

NewStone has been tested in-house and by Twin City Testing Labs under standards associated with hardboard and particleboard. NewStone currently meets all specified conditions for interior applications and meets most requirements for protected exterior application.

This breakthrough in bioengineered materials technology represents an entirely new industry for the United States and a new market for agricultural products. NewStone represents only the beginning of a multitude of materials and revolutionary product potentials spanning furniture, building design, flooring, wall paneling and other uses which are only limited by the time it takes to develop new engineered composites based on this resin system.

AGRICULTURAL IMPACT

The basic agricultural materials used to produce NewStone are soybean flour derived from soybeans and recycled newsprint derived from wood products. NewStone will span many enormous markets and even minimal penetration of these markets will result in an increased demand for soybeans. Fifty-five pounds of paper and 1 bushel of soybeans represent 22 board feet of NewStone material. A board foot is twelve inches by twelve inches by one inch.

The Mankato pilot plant operation of Phenix Composites, Inc. was initially designed to seed select markets and to supply expert engineering information to develop a full scale production operation. Even this small pilot plant will utilize sufficient processed soybeans to affect production of local soy processing plants. Forecasted annual projections of soybean flour usage for 1996 exceed 11.3 million pounds of soybean flour for the Mankato plant. We anticipate that the Mankato plant will be a full production facility by 1996.

This usage represents a very small percentage of any potential market. For example, if PCI provided 1 percent of the window products for one large Minnesota manufacturer, PCI would use 3.6 million pounds of soy flour to create the 1.2 million board feet of NewStone necessary to provide the window products. This large window manufacturer processes over 120 million board feet of pine annually, representing 500,000 board feet per day. If this material were replaced by NewStone, over 1.5 million pounds of soybean flour would be required daily (37,500 bushels).

There are tremendous potential domestic and foreign markets for soybeans through NewStone. Current environmental issues, like recycling and diminishing forests, higher prices for wood products, and worldwide lack of building material will further assist in the acceptance of NewStone.

Phenix Composites, Inc. believes that the production of NewStone will positively impact Federal crop subsidies or other agricultural assistance programs. Those programs which relate specifically to soybean crop subsidies could be assisted in the following fashion:

—The overall image of all soybean products would be positively affected by the introduction and success of NewStone.

—The production process of NewStone directly impacts the soybean industry, providing an opportunity to capitalize on the positive image equity that results in being directly associated with NewStone.

—Crop demands will be directly or indirectly affected by the production of NewStone.

Phenix Composites, Inc. plans to license NewStone for production in many domestic and international plants. These plants will be located near source material in order to reduce the cost of shipping bulk soy flour and waste paper. The introduction of production plants will produce jobs and will directly benefit smaller, rural communities since the plants are likely to be located near soybean producing areas.

The production of NewStone will reduce the amount of waste paper deposited in landfills. Currently, 40 percent of all garbage collected and dumped in landfills consists of waste paper.

TAXPAYER BENEFITS

NewStone has unlimited applications. Producing resin for NewStone and manufacturing end-products will add corporations and jobs to the tax base. The technology used to create NewStone will be applied to create additional products from different wood fiber fillers, thereby repeating the cycle of growth.

Other justification for public support can be derived from the impact that NewStone has on the preservation of diminishing natural resources and the direct and indirect impact that it will have on Federal crop subsidies or other agricultural assistance programs.

In addition, export opportunities will generate additional revenue because NewStone will benefit from international concern over the environment. The "green" aspects of NewStone will make it particularly appealing to the European Economic Community which has already passed legislation banning imports of green softwood lumber from areas infested by the pinewood nematode. NewStone will not be affected by this type of environmental legislation, thereby giving it unique opportunities within the softwood veneer and plywood markets throughout the European Economic Community in the area of desk furniture.

Recent U.S. wood export trends indicate that countries like Japan, Canada, Mexico, and Germany offer immediate opportunities for NewStone.

EFFECT OF FUNDING FROM AARC

Phenix Composites, Inc. has carried the development of NewStone to the point where commercialization and volume production is indicated. The funding to date has been provided by private financing augmented by research grants from soybean check-off funds through both the Minnesota Soybean Association and the United Soybean Board. Given the cautious posture of conventional sources of expansion capital, our present pilot line would produce and we would market in only limited quantities to "seed" only a few applications for some time.

With early indications of potential funding from the AARC, Phenix Composites prepared a plan for final design and building of a line of specialized computer controlled equipment which will permit the continuous, multishift production of NewStone. We now anticipate a scale-up from pilot plant to commercial production by the end of this summer. The announcement of final approval of the AARC loaned funds was the final trigger for the placement of more than matching equity funding from private investors, now completed.

Funding the production of NewStone directly supports the goal of the AARC to accelerate the commercialization of industrial products derived from farm and forestry materials, creating jobs and economic activity in rural America. According to the AARC, a number of factors have come together to make the use of farm and forest materials in industrial uses more viable in the 90's. These factors are: 1) more efficient technologies for processing and manufacturing; 2) environmental and regulatory requirements for clean air and water, landfill alternatives, disposability, and renewability; 3) availability of skilled labor and resources in rural America; and 4) increased pressure to reduce agricultural subsidies. NewStone is THE ANSWER to these challenges.

Without this funding, Phenix would not be able to realize full-scale production. Phenix will use the $1 million cooperative agreement award and the added private placement funds to purchase equipment and to provide working capital to take the company from the pilot stage to a full-production facility. Without AARC funding, Phenix would not be able to move into full production. And without full production, Phenix would not be able to produce full-size (3 × 6 to 4 × 8) sheets of NewStone, needed in order to penetrate the larger wood products industries.

Senator **Daschle**. Thank you very much, Mr. Riebel.

I am fascinated by this board. I assume you can add dyes and make different colors.

Mr. **O'Connell**. Green. How many different colors do you have?

Mr. **Riebel**. Right now, we have 50 different colors in market research. We have just released one that looks exactly like burled walnut, and it has received an immense amount of interest from the furniture industry in North Carolina and Michigan, enough that we would have to start considering joint venture factories down there.

Senator **Daschle**. One of the questions that I was going to ask Mr. Carver, and I guess it is appropriate to ask it now: From our experience in ETBE and ethanol, we always come up with the price competitiveness problem. We can produce a better product. We just can't always meet petroleum products' prices sometimes, because of all the built-in market advantages that the petroleum industry has compared to ethanol or methanol. Are you at a point where you can be price competitive with existing building materials at this point?

Mr. **Riebel**. We looked at it from a market approach. Obviously, materials like Corian, real granite, as we look around here, is very expensive and a very desirable material. We have positioned this to be in the real wood price range, which is significantly less by a factor of four than any other competing materials, and it is still incredibly high value-added for the product. So we really positioned it from the market first and then moved the technology to meet that. Our goal is to come up with very advanced materials that can be worked like wood, priced like wood, but that have the elegance of granite and Corian, and then engineer it to meet the market needs.

Senator **Harkin**. Could you use this like you use Corian? Will it withstand heat?

Mr. **Riebel**. This is a whole new technology that we will engineer in different materials for different markets. This one will go into furniture, millwork; picture frames or replace oak flooring. We have a second grade that will be coming out with funding from the United Soybean Board that will be for countertop grade, which will be a different material. We are also looking at an exterior grade.

The markets are so extremely large for us, it is very difficult to try to approach them all, and it has been very helpful to work with AARC to get us going and commercialize this as quickly and meet the market. The market is right here for us today and we will be producing this summer. The environmental concerns, the price of wood has all helped us move along and make this agriculture-based product a very good one.

Mr. **O'Connell**. When we went to visit—and as I indicated in my testimony, we visited, myself, one of the staff and a Board member visited every one of the projects—but when we went to visit the Phenix location, we had the same question you did with regard to structural integrity. We had Roger Porter, who is a materials scientist from the University of Massachusetts, specifically look at this and to examine it and see whether it really had that kind of support.

He indicated, and as Mike Riebel well knows, it is chemically and structurally bonded. It is not just where you put together material and hope that it stays together. It both chemically and structurally comes together. We indicated to Mike that one of the areas they have to be concerned about, as he well knows, is getting product on the market and getting sales coming in, because they have been primarily R&D for how many years, two or three?

Mr. RIEBEL. About a year and a half or a couple of years.

Mr. O'CONNELL. So a tremendous outlay of capital and so forth, and so we indicated to them, and I think they agree with this, is to focus initially on the furniture market and decorative panels and so forth, and then as you get sales going, move into other areas.

But from the standpoint of the furniture, you can put it as inlay, like in this table here, and work it just like you would the other wood so that it truly is a part of that particular structure, a desk or furniture or whatever the case might be. But for that particular use, every indication is that it is going to have the kind of structural integrity over a period of time that it needs to have. And I think, as you well know, as you move into those areas where water and those sorts of things are a real problem.

Another aspect of it, we were worried—after all, this is soybean meal and waste paper, what about bugs and fungus and all those kind of good things—but as I understand it, the chemicals and things you put in there are going to resist that sort of thing. So even if it gets chipped, that won't be a problem.

Another thing, you are not going to sell this like in a lumber yard. This is only going to be part of an integral process, and so when it is processed, it will be properly covered, all those aspects of it. We had some of the same questions, many of the same questions that you are bringing up. So I think for the initial application, it looks like it will have the structural integrity and longevity that it needs to have.

Senator DASCHLE. Very good. Thank you.

Our final two witnesses are here to talk about a project that they have been working on for some time. Mr. Bob Herzfeld is the Marketing Manager of Cenex/Land O'Lakes Agronomy Services, and Mr. Mark McAfee, the Assistant to the Executive Director of the Agricultural Utilization Research Institute.

Gentlemen, we are pleased you are here. Mr. Herzfeld, we will take your testimony at this time.

STATEMENT OF BOB HERZFELD, MARKETING MANAGER, CENEX/LAND O'LAKES AGRONOMY SERVICES, ST. PAUL, MN

Mr. HERZFELD. Thank you, Mr. Chairman. Thanks for having me here to talk to your committee this morning.

I am Bob Herzfeld, marketing manager for Cenex/Land O'Lakes Ag Services, in St. Paul, Minnesota. I am here to give you a synopsis and the background of an agriculture-based product that we came to market with last year, thanks to the help of the Agricultural Utilization Research Institute of Minnesota, and we also had some support from the USDA previous to the AARC's creation on some funding from the CRSC.

Cenex/Land O'Lakes Ag Services is a marketing function for Cenex/Land O'Lakes regional cooperatives joint venture. We are a supply cooperative and we supply approximately 1,500 local cooperatives in 15 States. Our trade area reaches from Wisconsin to Washington and south to Kansas. Our main purpose is to serve our member-owners and our farmers. Any profits that we generate are given back to the farmers through patronage refunds.

Our part of the organization, the crop protection area, has been supplying crop protection products to farmers since the 1950's, and we have also been supplying another group of products called spray adjuvants since the early 1970's. Spray adjuvants, I would like to mention to you, are anything that you add to a pesticide spray solution that itself is not a pesticide, and they are usually petroleum based. Most of these adjuvants being crop oil, particularly petroleum-based oils, are not regulated by the EPA, and so we don't have to come under any formal labeling processes.

Cenex/Land O'Lakes, since the early 1980's, did market one soy-based product and it was fairly successful. We wanted to continue marketing a soy-based product. Unfortunately, the technology in our crop protection business has grown so fast that new products are coming onto the market now calling for nonionic surfactants. A nonionic surfactant is basically a product that has a neutral charge. It doesn't react with the chemistries that are in the spray solution that we mix with it.

Preference is a new product, a soy-based product, where all of the nonionic surfactants today on the market are petroleum-based. This left us in kind of a dilemma, as this market changed, and we were looking for a crop-based nonionic. We had some ideas from the people in our company that worked with them of how to do it, and we also had a product or a byproduct that was given to us by the Minnesota Soybean Growers Association. This byproduct is from soybean oil refining, and basically it is a waste product.

We felt that we could incorporate this byproduct, because it had some characteristics that we felt would work very well as a nonionic. To find out if this was a viable marketable product for an idea, we found ourselves with a very huge task of trying to test this in the laboratory. We also had to test it over many different States and on many different crops in many different conditions.

As I mentioned, Cenex/Land O'Lakes Ag Services is primarily a marketing organization, and we have some formulation capacity, but we are not basic researchers and we are not formulation engineers, and we don't have any budget to try to become so.

This is where we found that the AURI's assistance of $57,000 came to our aid in June of 1989. They provided us the grant funds to get the project off the ground and motivate our company to start on the thing. We also got grants of $20,000 from the USDA.

In October of 1989, we formulated our first product for test, testing with the hopes of developing a product as good as the petroleum-based product we were presently marketing. By utilizing our grant funds, we then contracted with the University of Minnesota for two years of field research. We found it very, very important that we prove that this product worked as well as to our member-owners.

As the first results starting coming in from the testing from the University of Minnesota, we immediately found that our product was not just working as well, but it was working better, and in some cases significantly better. At this point, we realized we had a winner.

In December of 1991, we formally introduced our soy-based nonionic surfactant to the agricultural market and to our farmer member-owners. The following spring, the first product hit the ground by our dealer applications and growers. Our report card of our first year, in 1992, is that we covered over four million acres of crop ground and noncrop ground, and we did this without one single performance complaint, but we did receive a number of accolades.

This four million acres was four times our company's original projection. The first year's volume represented utilization of byproduct generated from soy oil refining from 1.5 million bushels of soybeans. Byproduct from approximately 15.2 bushels of soybeans goes into every gallon of our nonionic. The first year's volume also represented the potential savings of $1 to $2 per acre to growers, and how we arrive at that is that if we went over four million acres and were able to save them $1 to $2, of course, that would add up to that savings.

With our resounding initial success and market indications that we are getting for our next year, we believe that we will easily cover 10 million acres with this product and that we will utilize enough byproduct from soybean oil refining to represent 3.75 million bushels of soybeans, and even a greater potential in savings per acre by not having to use premium adjuvants recommended by other chemical companies.

We really would like to thank the AURI for the assistance to help put us and our company in a win-win situation with our member owner-dealers and the farmers they serve.

In conclusion, I would like to say that we work very well with the AURI of Minnesota on the State level, and we truly welcome any future opportunity to work with the AARC in the future.

Thank you, and I would take some questions.

[The prepared statement, with attachment, of Mr. Herzfeld follows:]

PREPARED STATEMENT OF BOB HERZFELD, MARKETING MANAGER, CENEX/LAND O'LAKES AGRONOMY SERVICES, ST. PAUL, MN

Mr. Chairman, members of the subcommittee, I am Bob Herzfeld, Marketing Manager for Cenex/Land O'Lakes Ag Services in St. Paul, MN. I'm pleased to be here today, to provide you with a synopsis of an agricultural product introduction made possible through the support of the Agricultural Utilization Research Institute. The hearing today concerns the USDA Alternative Agriculture Commercialization (AARC) program. While our product was developed prior to AARC's creation, it did include USDA participation and is an example of the type of new uses product development and commercialization suitable for the AARC program.

First let me give you the background of my company. Cenex/Land O'Lakes Ag Services is the marketing function of the Cenex/Land O'Lakes cooperatives joint venture. We're a supply cooperative to approximately 1,500 cooperatives in 15 States, with territory from Wisconsin, west to Washington and south to Kansas. As a cooperative, we are entirely owned and controlled by farmers. Our only mission is to serve farmers, and all profits are returned to farmers through patronage refunds.

Cenex/Land O'Lakes Ag Services is positioned as being innovative, and active in the introduction and sales of environmentally and agronomically correct products and services. Indeed, our environmental mission, which was adopted in 1989 is: "To actively and responsibly support stewardship of our natural resources, while maintaining a positive balance between the environment, the economic well-being of agriculture and global food needs." That is a challenge we take very seriously, and one that I'm hopeful I'll be able to demonstrate our commitment to through the case history of a product called Preference nonionic surfactant.

I must start with an agronomy lesson on something called adjuvants, which are defined as anything added to a crop protection product tank mix—after it leaves the original manufacturer—to improve the chemistry's performance. Adjuvants are NOT pesticides, and are therefore NOT regulated by the Environmental Protection Agency (EPA). From about 1975 onward, Cenex/Land O'Lakes enjoyed tremendous success marketing and distributing crop adjuvants. They were manufactured from petroleum and vegetable oils.

SITUATION ANALYSIS

In 1987 the crop protection products and adjuvants market began changing dramatically. The need for adjuvants/additives began increasing due to the popularity and market acceptance of postemergence herbicides, the introduction of dry flowable (DF) products, and low dosage technology. Federally approved labels for these new chemistries specify use of a nonionic surfactant, rather than the traditional petroleum- or vegetable-based crop oils.

Nonionic surfactants are a class of surface agents that have no charge (either positive or negative). Their purpose is to lower the surface tension of the spray droplet allowing it to wet or spread over the leaf surface more effectively. They also aid in penetration of the chemical molecule through the leaf cuticle. There are a number of adjuvant manufacturers, with varying degrees of legitimacy and ethical standards. Because of this, we require thorough performance testing of all our products prior to market introduction.

Nonionic surfactants enhance crop protection products' performance. This is extremely important to a farmer's profitability. With this trend in mind, the Cenex/Land O'Lakes crop protection product division goal for the '90s was to develop a partial or totally crop-based adjuvant. In other words, we wanted to replace the petroleum base with a crop base.

ECONOMIC IMPACT

The introduction of Preference nonionic surfactant represents an entirely new industrial use for soybeans, and specifically creates another market for soybeans. Every gallon of Preference represents the utilization of byproduct from 15.2 bushels of soybeans. 1992 sales totaled 100,000 gallons, which translates into utilization of 1.52 million bushels of soybeans.

Preference is manufactured at the Cenex/Land O'Lakes agronomy facility in Winona, Minnesota, creating additional local employment opportunities for five people. In 1992, the gallons manufactured represent 7,000 additional man hours and we expect this to significantly increase as the volume grows.

In 1992, Preference was applied to four million acres. 1993 acreage is expected to reach ten million acres. In addition, since 1991, an advertising budget of approximately $225,000 has been distributed to the media and advertising agencies in Minnesota, Wisconsin, Iowa, North Dakota and South Dakota.

Savings to farmers are also very impressive. Because our product was priced below some other premium priced competitors, farmers saved roughly $2 an acre when using a soybean herbicide, or $1 more per acre on corn herbicides. In other words, the introduction of Preference resulted in the potential savings to farmers of between four and eight million dollars. Plus, we were also using their crop in the production.

MARKETING STRATEGY

Preference was officially introduced in December, 1991. The unique selling promise is, of course, the use of soybean ingredients in the manufacturing process. Farmers react very positively to new, innovative uses for their soybeans, and Preference was no exception. Advertising messages directly communicated the use of soybeans, and the superior field trial results.

We have also formed strategic marketing alliances with the American Soybean Association State chapters in South Dakota, Iowa, and Minnesota. By way of reference, these associations are groups of farmers that have organized themselves with the purpose of promoting soybean utilization in their own States.

A second strategy provides for a monetary donation from every gallon of Preference sold to the Agriculture Council of America's FoodWatch program. FoodWatch is an educational public awareness campaign to improve the public's perception of the safety of America's food supply. In 1992, $15,000 was donated as a result of Preference sales.

AURI PARTNERSHIP

In 1989, the marketers and agronomists at Cenex/Land O'Lakes began working to isolate a marketable crop-based nonionic surfactant. We were specifically interested in a fatty acid produced as a byproduct of soybean oil refining. Preliminary laboratory tests indicated the soy product would work, thus fulfilling the goal of developing an alternative product with performance at least equal to our existing adjuvants. At this juncture, however, we were in need of funding to fully test our theory. Our company's focus has been on the economical distribution of quality products, versus research and development. We also didn't have adequate laboratory facilities, nor a research and development budget. The Agricultural Utilization Research Institute (AURI) was a natural partner.

In June, 1989, AURI provided a $57,793.15 AURI grant and a $20,651 USDA Cooperative State Research Service (CSRS) grant for two soybean utilization projects. Cenex/Land O'Lakes matched the grant with $78,000 in research funds. In October 1989 the first product was blended and performance testing began. Many of the field trials were performed at the University of Minnesota in three different locations, one in Iowa, one in Washington State, and one University of Wisconsin location. A total of 36 replicated research trials and 24 on-farm comparisons involved using the product with 23 different herbicides. Results indicated the product performed in an outstanding manner, being "equal to" other products in 77 field trials, "better" than other products in 37 field trials, and "significantly better" in 22 trials, when compared to two other leading surfactants. In December 1991 the product was officially introduced to growers under the name Preference. Preference has received industry recognition and accolades, and is in fact recommended for use with a variety of soybean and small grain herbicides across our trade area. Let me assure you that Preference represents a significant marketing opportunity. **AURI is to be credited with having the foresight for sensing an excellent idea, and for assisting us in the development of a marketable product.**

Aside from the monetary contribution, AURI's endorsement greatly legitimized the project. University researchers then perceived the project as being worthy, and ultimately marketable. It wasn't something that just one company felt was viable. AURI also provided contacts within the industry of similarly interested parties, to further fine-tune our marketing and production strategies. They truly had the best interests of agricultural research and growers foremost in mind. In conclusion, we have worked well with AURI at the State level and will welcome any future opportunity to work with AARC, which appears to be a worthwhile Federal endeavor.

Mr. Chairman, I will be pleased to answer any questions.

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THIS IS CENEX/LAND O'LAKES AG SERVICES

Cenex/Land O'Lakes Ag Services is a joint marketing venture involving two of the nation's leading agricultural supply cooperatives. With more than $2.7 billion in annual sales and 130 years of combined experience, the joint venture serves approximately 320,000 farmers and ranchers through more than 1,600 local cooperatives in 15 states across the Midwest and Pacific Northwest. Cenex/Land O'Lakes Ag Services supplies those local cooperatives with a wide range of petroleum products; feed; seed; plant food; crop protection products; farm products; animal care products; tires; batteries and accessories; agricultural equipment; transportation services; and farm and ranch management services. Cenex/Land O'Lakes customers can count on:

Through Cenex/Land O'Lakes Agronomy Company –

* an agronomy operation that serves the largest network of plant food dealers in North America, backed by Cenex and Land O'Lakes combined 38 percent ownership in CF Industries, one of the nation's leading plant food manufacturers.
* a major supplier of crop protection products that distributes more than 700 products through 27 strategically located Express centers.
* the owner of Imperial, Inc., a crop protection products formulating company which produces Cenex/Land O'Lakes-branded products at Albert Lea, Minnesota, and Shenandoah, Iowa.
* a provider of a wide range of seed and agronomy technical services available through the retail agronomy services program: 130 Crop Production Specialists, the Croplan Retail Training Program, Centrol and Agri-Source and AgriSource/Centrol Lab.

Through Land O'Lakes –

* one of the nation's leading feed suppliers, with nearly 300 feed manufacturing plants in the system.
* the number one feed program in the Upper Midwest through a growing number of feed consulting and sales programs.
* one of the nation's leaders in the manufacturing and sale of animal milk replacers, with major international sales.
* a major member of Cooperative Research Farms, the world's largest livestock research network.
* the expertise of Answer Farm, a leading animal and plant research facility, and more than 600 research and development plots across the trade territory, supporting a complete system of crop production and livestock products and services.
* a basic seed producer, with strong research and conditioning plants located throughout the territory.
* a major marketer of hybrid corn, soybeans, forage and turf seed.

Through Cenex –

* a petroleum company that is the nation's 55th largest oil producer, holds the 69th largest worldwide oil reserves and has the 64th largest domestic oil reserves among the top one half of one percent of the nation's oil companies.
* a significant wholesaler/reseller of over 1.3 billion gallons of refined fuels with ownership of a 42,500 barrels per day refinery at Laurel, Montana, and a 74.2 percent ownership in the National Cooperative Refinery Association, with its 75,000 barrel per day refinery at McPherson, Kansas.
* an operator of 918 miles of crude and products pipelines and eight terminals.
* one of the nation's top four propane suppliers,
* a leading operator of card and key activated gas dispensing systems serving more than 500 communities.
* the blender of more than 60 types of lubricants, for everything from small engines to automobiles to heavy equipment and industrial machinery.
* the developer of new petroleum retail outlets including Cenex convenience stores, Cenex car and truck stops and Cenex Fast Lube.
* a major credit card marketer with the Cenex Convenience Card.
* one of the nation's larger private truck fleets with all of the specialized equipment required to serve the transportation needs of agriculture and rural America.
* a combined Cenex and Land O'Lakes 24.3 percent ownership in Universal Cooperatives, a farm, ranch, home and vehicle (tires, batteries and accessories) products and equipment supplier.

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Senator DASCHLE. Thank you, Mr. Herzfeld.

Mr. McAfee, did you have any additional comments to make?

STATEMENT OF MARK McAFEE, ASSISTANT TO THE EXECUTIVE DIRECTOR, AGRICULTURAL UTILIZATION RESEARCH INSTITUTE OF MINNESOTA, ST. PAUL, MN

Mr. MCAFEE. Mr. Chairman and members, I would say that today we have with us besides myself at AURI, we have in the audience Gordon Sanstale, who is with the Minnesota Wheat Growers. He is the chair of our 11-member board of directors and is 1 of 5 producer-members on that board; also Max Norris, who is director of applied research and is one of our technical people who worked with Cenex/Land O'Lakes in this product formulation.

I did submit to you a written statement and I do have some comments that I could make at this time or during questioning regarding the overall AARC program.

[The prepared statement of Mr. McAfee follows:]

PREPARED STATEMENT OF MARK MCAFEE, ASSISTANT TO THE EXECUTIVE DIRECTOR, AGRICULTURAL UTILIZATION RESEARCH INSTITUTE OF MINNESOTA, ST. PAUL, MN

Mr. Chairman, and members of the subcommittee, I am Mark McAfee, assistant to the executive director of the Agricultural Utilization Research Institute (AURI). AURI is a nonprofit corporation created by the State of Minnesota to strengthen its economy by developing new uses for Minnesota farm products. AURI's role is to build working partnerships that combine Minnesota's diverse agricultural resources with business innovators, applied researchers, and rural development professionals.

On behalf of our board of directors and executive director Richard Nelson, I appreciate the opportunity to provide written testimony regarding our evaluation of the implementation of the Alternative Agricultural Research and Commercialization program (AARC) to date. In addition, I am pleased to share with the subcommittee what has worked best at AURI and how the AARC Board can benefit from our experience.

In order to assess the AARC program's progress to date, it is helpful to review its purpose, as authorized in Subtitle G of Public Law 101-624:

1. Authorize research in modification of agricultural commodities, and associated research, in order to develop and produce marketable products other than food, feed, or traditional forest or fiber products;
2. Commercialize new nonfood, nonfeed uses for traditional and new agricultural commodities in order to create jobs, enhance the economic development of the rural economy, and diversify markets for raw agricultural and forestry products;
3. Encourage cooperative development and marketing efforts among manufacturers, financiers, universities, and private and Government laboratories in order to assist the commercialization of new nonfood, nonfeed uses for agricultural and forestry products;
4. Direct, to the maximum extent possible, research and commercialization efforts toward the production of new nonfood, nonfeed, products from agricultural commodities that can be raised by family-sized agricultural producers; and
5. Foster economic development in rural areas of the United States through the introduction of new nonfood, nonfeed products obtained from agricultural commodities.

The AURI mission is similar to AARC's, with a strong focus on rural economic development and new uses research, development and commercialization. Our mission is slightly broader, in that we can assist companies to develop innovative food and feed products, as well as nonfood, nonfeed uses:

The AURI mission is to foster long-term economic benefit, and increased business and employment opportunities for rural Minnesota by:

1. Identifying, expanding and creating new markets for agricultural commodities, ingredients and products;
2. Developing more energy-efficient, natural resource-saving farm production practices; and

3. Developing new industrial uses and value-added food products from Minnesota agricultural commodities.

AURI was authorized in 1987, began program planning in 1988 and was formally launched in its present form in 1989. In terms of program planning and development, we have five years of experience to draw upon, versus just over one year for AARC.

Over the last five years, we have learned many lessons on how to successfully operate a program. Like the AARC Board, we began with a series of public hearings to gain input on program design and implementation. Such hearings provide the public with an opportunity to suggest program options and research areas. We participated in the hearing held in Bloomington, Minnesota which was very well attended and salute the AARC Board for holding such hearings.

As is true in the Congress, hearings are the beginning in program design and implementation. Optional approaches must be considered and then the best program selected. One option is a centralized approach with a traditional proposal funding program. Requests for proposals are sent out from a central place and invited to return to the central place, with little opportunity for interaction.

At AURI, we started with a central approach and traditional funding mechanisms. From a central office, our Pilot Grant Program was launched with a broadly distributed request for proposals. We took the passive approach of sitting back and waiting for proposals to come in. We did not yet employ field staff to provide commercialization assistance. Nine projects were funded under this program and from the experience we learned some lessons which we hope can spare the AARC program from completely repeating our trials and errors:

1. Under the traditional, shotgun request for proposals, the bulk of proposals came in from universities. The proposed research was often interesting and valuable, but lacked a clear connection to the marketplace.

The lesson: involve the private sector early and often and insist that private sector companies be lead applicants. Make sure that the research agenda is market driven.

2. University scientists outlined great ideas for new research and development, but often lacked knowledge on how to interact with the private sector. AURI did not yet have a mechanism for facilitating such connections.

The lesson: design the program to facilitate the commercialization of new uses research.

3. Our early program operated from a major metropolitan area (Minneapolis), remote and not as easily accessible to rural-based customers. It was more difficult to meet face-to-face with clients and help them get started.

The lesson: decentralize the program to make it more accessible, more customer service oriented.

In 1989, we implemented this recommendation by opening four regional field offices in Crookston, Marshall, Morris and Waseca, which are cities ranging from 8,500 to 15,000 in population. From these rural-based locations, our Technical Services Managers carry AURI services to entrepreneurs and businesses with market ideas for new uses for agricultural products. AURI provides technical and financial assistance to clients to develop and commercialize products. As a catalyst, AURI often brings others with scientific, engineering, marketing or financial background to the table to assist clients. Such experts include university scientists, public economic developers and private consultants. The process works very effectively and is an excellent example of a public-private partnership.

AURI field offices are backed up by a headquarters staff in Crookston and laboratory and pilot plant facilities in Crookston and Marshall.

As a mechanism for this process, we replaced our earlier grant programs with the AURI Partnership Program and associated programs to involve private sector product champions right up front in commercialization projects. AURI services and levels of funding vary within prescribed limits according to specifically determined needs. Matching funds from $1 to $4 are required of applicants for every $1 provided by AURI:

- **The Initial Product Assessment Program** offers up to $9,500 in funding to private, for-profit businesses for short-term projects assessing the technical and/or economic feasibility of a new or improved product or process. Efforts are made to identify specific obstacles to commercialization and address potential solutions. If the Initial Product Assessment shows that a product or process is commercially feasible, the applicant can commercialize directly, using the results of the assessment as a guide, or apply to AURI's Partnership Program for additional support.

- The **Partnership Program** provides up to $100,000 per project to solve problems related to product commercialization. Partnership projects between for-profit business applicants and AURI are one to two years in duration. Potential Partnership applicants must come to AURI with a business plan and documentation indicating the market potential of a product or technology. This information might be derived from an Initial Product Assessment or material the applicant has gathered independently. The goal of a Partnership is to bring an agriculture-based product or technology to market, making it a commercial reality.
- The **New Markets Program** helps commodity and farm organizations and other agricultural groups identify agricultural utilization opportunities where a business is not yet involved in commercialization. Funds are available for conducting commodity market and feasibility studies, developing technologies that eliminate barriers to commercialization, and addressing market, public policy, research and industry issues that impact commodity utilization.
- The **Applied Research Program** provides a direct route to bring new technology to the marketplace. AURI applied research staff are working with agribusinesses, university-based scientists and USDA and Department of Energy programs to access new technology and link it with commercial partners. Major program emphases include value-added processing of cereal grains, oilseeds, and animal products, and industrial fermentation and process engineering to assist in innovations in agricultural waste management, alternative fuels, and industrial feedstocks.

What are the results of AURI's endeavors?

To date, the AURI programs have funded nearly 200 projects aimed at finding new uses, new markets and added value for agricultural products. Examples include:

- Cooperative research between AURI, Southwest State University, South Dakota State University and Minnesota Corn Processors (MCP) to develop and commercialize a process that will improve the efficiency of ethanol fermentation.
- Assisting CENEX/Land O'Lakes for the research and development of Preference, a new soybean-oil based surfactant used in the application of crop chemicals. The product replaces petroleum-based surfactants. USDA/CSRS participated in the project.
- AURI was instrumental in facilitating meetings that led to the formation of the Minnesota Native Grass/Wildflower Producers Association in December 1991. These alternative crops have aesthetic, economic and environmental benefits.
- Helping a small company develop a cat litter additive made from semolina flour, mint and corn cobs.

These are projects well grounded in agriculture and resulting in rural economic development. Commercialization of new uses, utilization of agricultural commodities, business expansion or startups and new or preserved jobs have resulted from these and other projects. Not all projects are successful, as they entail considerable risk. Many results are encouraging, however. AURI recently assessed 14 projects and found that AURI's total investment of $700,000 in the projects had been matched by almost $11 million in other investments, a 1:15 leverage of AURI funds.

We are convinced that we are on the right path to connect new uses research, development and commercialization with rural economic development. We have shared our experience with the AARC Board and staff through the AARC hearings and face-to-face meetings and have suggested that they skip a grade in our school of hard knocks and immediately design and implement a program patterned after AURI's successful program.

That would mean the creation of regional centers as authorized under the AARC legislation, with side-by-side participation by State-funded programs like ours and leverage of university new uses research and private sector marketing and financial services. We don't mean reinventing the wheel. We mean reinventing Government, to paraphrase David Osbourne, to make this new Federal program truly effective. AARC will not compete with AURI, it will complement AURI.

What have the AARC Board and staff accomplished since the hearings they held last year?

1. They initiated a request for proposals for new uses commercialization projects. While we do not yet have a complete list of the projects funded, our impression is that some good projects will be funded. This is a good start.
2. They invited proposals for regional centers through a second request for proposals. The Northern Regional Agricultural Utilization Consortium (NRAUC), of which

AURI is a participant, has submitted a proposal. We stand ready to work with the AARC Board and staff to implement the program. This comes even closer to the mark, once implemented.

What needs to be done?

1. The first round of projects funded by AARC should be evaluated to demonstrate valuable new uses research, product commercialization, and actual rural economic development.
2. AARC program delivery mechanisms need to be further refined pending the outcome of the regional center request for proposals.
3. The AARC Board and staff need to stay in close touch with the agricultural and rural interests they serve. The best way to do that is designate regional staff in field offices to proactively develop projects and listen to some of the best and brightest minds in rural communities, and fund their effective ideas.
4. The AARC program needs more dollars to make it effective. We suggest a minimum of $20 million for 1994, with a revision upwards in the next fiscal year if positive results are attained.

The AARC program is off to a good start. We want to help the program attain the bold new uses and rural economic development goals that the Congress intends it to achieve.

Senator **Daschle**. Okay. Why don't we go ahead and begin the questions. Let me thank all of you for excellent statements. This has been a tremendous presentation this morning, and your perspectives have all been extraordinarily helpful and very interesting.

Dr. O'Connell, let me pick up where I left off at the last hearing with a concern that I had about the distribution of the AARC funds. We talked a little bit about that at the last hearing, and you said that since there hadn't been any proposed projects and you had just published the request for pre-proposals, that it was a little early at that time to talk about distribution of AARC funds.

You have the responsibility to negotiate the agreements controlling the distribution of funds. How is that being done now?

Mr. **O'Connell**. Well, from the 48 full proposals and the Board selected around 20, about 15 in what we call the first quartile, and then there was 5 in the second quartile, and so what we did after they had selected those projects based on the full proposals, we went out and we actually sat down on-site. We just felt that was extremely critical, to be on-site with the people that put in these proposals, so we knew just exactly what the situation was and was what we saw in the report actually there on the ground.

So we have done that essentially on every one of these at this time. So when we were there, we looked at the project, asked other technical questions that the Board may have had, some business questions the Board may have had, and came back then again with a report, and both the Board member and the staff person responds to this yea or nay after the visit.

So we have done that with about, I would say, 15 or 14.

Mr. **Roetheli**. I think we have got 19 of them.

Mr. **O'Connell**. But the ones that we are ready to go ahead on is around 14 or 15. So right now what we are doing, and we are working with the contract people in the Department and the lawyers and so forth, putting together a cooperative agreement. We put it on a spreadsheet indicating where the funds come from, a certain amount of funds come from AARC, a certain amount from the private company in proposal, if they have any partners.

So one of the first things we want to ensure is that, over the period of the project, that the funds that are going to go into this project, that they both go into it early, they both go into it in the middle and they both go into it at the end, that it truly is a partnership.

One of the unique things I think of AARC is that we don't go into something unless there is a very strong commitment on the part of the private partner. Even though the legislation indicates about 80 percent we can go up to fund, the board has made a decision that, except in some exceptions, we want at least 50 percent of the funding from the private partner, at least 50 percent.

So we look at that side of the situation, and we also in the cooperative agreement we want a description of the kind of activities that we are going to carry out jointly, so that we know, we can go in and we have milestones and we have dates, so that we can go back, and that will be one of the things the regional centers will be used for, is to actually work with the people that we are in partners with to actually see if these dates are being met, and to try to help if they are not being met.

Right now, we are in the process of setting up these cooperative agreements, and then we will send them out to the private partners to sign them and then get the projects under way. That is where we are at right now.

Senator DASCHLE. As you know, the act currently says that the cooperative agreement cannot last longer than five years. Do you think that five-year period is sufficient to achieve the commercialization goals and repayment of the AARC funds?

Mr. O'CONNELL. I think that we are going to have to have that—that is one aspect of the legislation that I think needs to be changed. I think we will need, especially on the payback aspect of this, it should be longer than that. I think, in general, it should be 10 years, but it may be longer than that, so I think that should be changed in the legislation, quite honestly.

Senator DASCHLE. Does anybody else care to share a comment on that? I have mixed feelings about it, frankly. I don't want to see any long-term Government business contracts that perpetuate year after year ending up much like a lot of what we do in Government. That is, we just never quit spending on that particular thing, and we can always justify continued Government involvement and more Government support, and so ultimately you just create something that never dies.

I was one who thought that five years was a good compromise. For me, the jury is still out. I am surprised, frankly, that you have already concluded that five years is not enough, with only one year under your belt.

Mr. O'CONNELL. Let me just explain that a little further. I think so far as the Government payout, I think five years is fine. I think the Government should be involved a maximum of that.

What I am talking about is payback to the revolving fund may be longer than that. That is all I am saying, and that could be set up that far. On the Government side, so far as how they are involved in this project, I think it should be five years.

Senator DASCHLE. Well, I was going to get into that.

Mr. Gain, did you have something?

Mr. **Gain**. I was just going to echo that. I think that we need to look at those separately and I think you need to maybe stay away from in perpetuity in terms of payback, if there are some real questions about that.

Senator **Daschle**. Yes.

Mr. **Gain**. But if there is an opportunity to not only recapture and, in fact, build this fund that we have, additional funds to work with and funding some successful projects, and if you can do that over a 10- or a 15-year period, I think that is very appropriate and we need to seriously consider that.

Senator **Daschle**. Mr. Carver.

Mr. **Carver**. In our case, in the project, we are putting this up as a regular commercial business, and Dr. O'Connell and I have been talking about the ways that money goes into our project. Since we really have 2 choices (one is a loan with a certain percentage rate of return that gets paid back over a certain time period, which can be 5 years, 10 years, whatever), it could be concurrent with our commercial lending, or it could be as equity.

We are looking more and leaning more towards the equity. We are taking a risk and we think the reward is going to be high, and the AARC Center has looked at the same risk and the same reward and feels I think appropriately, if I may speak for you, that there is a better chance of making more money on the equity side and taking the same risks that we are taking.

The payout would be the same time that we get our payout, we get some money, they get some money at the same kind of a rate. We think, at least on some commercial projects, that makes more sense than making it a loan at a smaller return.

I was asked by one of the Board members what kind of return on a loan would we give, and I said the Government makes Treasury at three percent, I will give you that.

Mr. **O'Connell**. We haven't negotiated that. [Laughter.]

Mr. **Carver**. I think if you are going to take this step and make the investment, get the rewards of that same investment.

Senator **Daschle**. Yes?

Mr. **Reeve**. I was going to make a quick comment on that. We have already seen the diversity of the projects that we look at, and from that there is going to be just as big a diversity of success and the long term of the success. So I think it is important that we don't box ourselves in too quick to the point where we might have to eliminate a project, because the payout is too long.

Senator **Daschle**. Go ahead, Dr. Jolliff.

Mr. **Jolliff**. I would just second his comment there. I think it could be good to keep that open-ended, because virtually, by definition, with things that are really new, the reason that the average industry won't get involved is it is too long-term, but we don't want to create Government programs that go on forever.

Senator **Daschle**. Dr. O'Connell or any one of the members of our panel here, could you talk a little bit about your view of the repayment requirement in the revolving fund and how you view it to be set up to work? I would like to start with you, Dr. O'Connell. Give me your schedule for repayment and how you view the revolving fund and how that is going to work.

Mr. O'CONNELL. I will be honest with you, the Board and myself and others are evolving on this, and based on some other experience. I know AURI had some experience in this area, too, and we have talked to others that have had experience.

Initially, what we are looking at is one of three possibilities, either equity, percent of sales or some kind of a payback, either partial or full payment at some point in the future. Let me just take the sales, for example.

First of all, let me use Phenix Composites as an example. It is important for them to get up and get running so they are successful. We don't want to be taking money away from them just when they need it to make something happen. I think what we are talking about with Phenix Composites is something that when the sales get up to a certain point, we are talking about a percent of sales over a two- or three-year period.

But the important thing here, why even bother going into the joint effort, if we put a constraint on that particular small company before they are up and being successful? But I think it is important in the cooperative agreement—and, quite frankly, this is evolving—what defines success, you know. We don't want to get involved either in looking at a percent of profit or things that we would have to go in and have an accountant look at the books real closely. We want to look at something that is pretty straightforward, like sales, like equity, like some kind of an agreed-upon payback.

And the payback thing that we are talking about would be above whatever the Federal Government is paying for money. We don't want to get into the situation like some other programs are, where actually they are paying back less than the Government pays for money. We don't want to get in that situation. So whatever the Federal Treasury notes are, say some level above that and, again, each one would be somewhat different.

What we are looking at right now is those three kind of combinations and each one is somewhat different. What we would do with Phenix Composites is maybe different than what we do with Arkenol and may be different from what we do with Aquinas and each one is somewhat unique, so that is kind of how we are looking at it.

Senator DASCHLE. Wouldn't you agree, as Dr. Jolliff had mentioned, that the degree of discretion is related directly to the degree of scrutiny. Therefore, if you want to have a lot of discretion, but there aren't hard and fast guidelines—I understand in this case you probably can't have guidelines, because you are dealing with a lot of different kinds of situations here—it seems to me that you set yourself up to be accused of somehow playing favorites. That is, you come up with a sweet deal for one company and not another. For this reason, you are going to have to go overboard in ensuring adequate public attention, scrutiny, oversight, call it what you will, and there has to be the belief out there that nothing you are doing is somehow connected to an arrangement that you don't want to share publicly.

Mr. O'CONNELL. And to follow up on that, as you know, Mr. Chairman, I was involved in the sustainable agriculture program and we had GAO look at the program and it came out rather successful. But being that this is a new program, we are dealing with private people out there and the potential of showing favorites is there, as you well indicate.

I can guarantee you, two years down the road or, at the most, three, we are going to be looked at from the standpoint of an outside audit, and we welcome that. We are making every point in our documentation in developing the projects we are funding and this sort of thing, in anticipate that will occur. I agree, we need to go overboard.

Senator **Daschle**. What you just said is certainly plausible. I understand that approach and, in fact, subscribe to it. But it does lead me to wonder about the degree to which we will have a revolving fund at any time in the near future with which to turn these monies around and reinvest. Could you elaborate a little bit on that?

Mr. **O'Connell**. I would say, of the 20 that we are looking at, I would say that about—well, let me just take one, for example, and that is the windshield washer fluid. I would say—wouldn't you say, Jeff, within two or three years, that we could—basically, what that one is is basically we are helping marketing, help set up lines. There is not a big technical aspect of this project. It is working with Goodwill Industries get this project under way. I would say in a very short period of time that we would have payback.

Mr. **Gain**. Payback within two years.

Mr. **O'Connell**. Within two years. I would say when we are dealing with—what we are talking about now is beginning to pay back at around three years. We have some others in here. We have about three or four new crops. As Dr. Jolliff well knows, you are talking with new crops a tremendous difficulty of getting those to the market within a short period of time. You are talking five, six, seven years down the road.

So I would say with about three or four of these, we are talking about a fairly near-term payback, two or three years, some more on the order of three, four or five years, some on the order of six, seven, eight years, depending on the nature of the projects, and that is kind of what we are looking at.

Senator **Daschle**. Is it just the nature of projects?

Mr. **O'Connell**. Yes.

Senator **Daschle**. It is?

Mr. **O'Connell**. Yes.

Senator **Daschle**. The reason I ask that is, are you telling me that if Procter & Gamble and Phenix Composites both come in with a similar project, that they are going to get equal consideration?

Mr. **O'Connell**. That is a good question. I think that what we are looking at is the project itself, I don't think we have made a distinction at this particular point in time as to the ability of the company. That is a valid question. Maybe you would like to respond to that, Lee.

Senator **Daschle**. Mr. Gain, you have been——

Mr. **Gain**. Yes, I would love to respond to that. [Laughter.]

This is as very difficult question to answer and it goes back to the new Farm and Forest Products Task Force report and very particular attention to where this focus is going to be.

One of our major concerns in this whole developmental effort, and it is tied into this publication that Paul passed out here earlier, is the rural development and the economic development activity of this thing. We want to create new industries and new areas and new emphasis on new products and new areas and new crops.

This is not to say that Procter & Gamble or ADM or somebody else who is big in the business shouldn't be given consideration, but there needs to be careful consideration given to this aspect of it, and I think probably maybe even some disproportionate preferential consideration given for those kinds of opportunities.

With reference to the question on funding, I think the payback question needs to be considered along with the authorization contained in the 1990 farm bill, which are falling considerably short of funding levels that were envisioned at that time. I understand budget concerns, but I think we are looking at total cumulative appropriations of somewhere in the neighborhood of $650 million, as I recall, which is a little short of the $1 billion.

But the more we invest, is my point. How much could you have spent, Paul, in terms of the good projects or the projects that we——

Mr. O'CONNELL. Well, about half of the 400 had merit. We would have had to have gone out and helped them get private partners and so forth, but the total was $275 million, wasn't it?

Mr. ROETHELI. $448 million was the total budget.

Mr. O'CONNELL. So I would say about half of that $270 million, which would be about $135 million.

Mr. GAIN. So considerably short, maybe a 10th of what we need, and you are going to have indications already I think that when your next round of proposals come in this summer or maybe this fall, you are going to have probably even more interest. So I think we are looking at payback, and what time period here, we need to be looking at the investment up-front, too, because this is stimulating a lot of response, and I think the more that we can be involved and generate this kind of activity, the more payback we are going to get sooner. So we need to look at that aspect of it.

Senator DASCHLE. Mr. Gain probably said it as well as anyone can. I share his view very strongly that two other criteria, probably not as prominent as the project itself, but two related criteria would have to be a needs assessment and a job and rural area impact assessment.

Mr. GAIN. Yes.

Senator DASCHLE. I think what Mr. Riebel is doing in Minnesota goes beyond just the value that he presents in an innovative new product from agriculture. He is creating jobs in Minnesota, and he is a businessman who probably doesn't have the resources that Procter & Gamble has, and so, from that perspective, this need also ought to require some consideration. I would hope very much that we take into account those two considerations, in addition to the quality of the proposal, as you consider projects in the future.

Mr. O'CONNELL. Let me give this to you. I put this together. In the full questionnaire, we ask things like job creation. Initially, after four years—and I just listed about eight of the projects there that we have—long-term utilization, environmental added—we can add better information to this in the future, but I just wanted to put down some quick numbers to show that this was one of our very strong considerations, and in our annual plan, Mr. Chairman, this is part of our documentation that we provided in our annual report, and in there is also the copy of our plan and so forth.

As I mentioned at the last hearing, one of the key aspects as to whether we are successful are things like products penetrating the markets, new business created, direct jobs created, the number of acres to substitute domestic production for imports, partnerships formed, effects on the environment, those were part of the full proposal and indications that the Board used very directly in deciding which projects to fund. That was a serious consideration.

I will be honest with you, I was somewhat worried until we actually selected the projects, but the way it turned out, as to the kind of firms that we would be funding, and the way it turned out was that we have 14 small entrepreneurial firms, 1 ag co-op, 2 nonprofits, 2 medium-sized firms and 2 larger firms. I mean the emphasis is on the smaller firms like Phenix Composites. I don't think that was any design on the part of the Board up-front, but they were very cognizant of the need to help small firms and the rural economic aspects of it, and so, yes, in the Board's deliberations, these kind of considerations were very important.

Senator **Daschle**. If we haven't already done so, I want to make sure that the annual report is put in the record.

Mr. **O'Connell**. Yes, it needs to be.

[The report referred to is retained in the committee file.]

Senator **Daschle**. I would also like to ensure that all of the current projects that have been approved be listed as part of the record.

Mr. **O'Connell**. Yes, we will.

Senator **Daschle**. Dr. Jolliff.

Mr. **Jolliff**. Two points, Mr. Chairman. One is relative to rural communities development and farmers. In my written testimony I have addressed that a bit and I give a theoretical situation that I think reflects the history that we want to be careful about in the future. The land-grant university system, of which I am a part, has been very much involved in increasing productivity, as has been mentioned by Senator Conrad and Senator Harkin, I think as well as yourself.

The farmers get caught in the middle. They produce more per acre and end up going bankrupt, while suppliers, shippers, and processors may be primary benefactors. I think that is what you are driving at. I would add my support to keeping family farm benefits as a high visibility priority in the proposal selection process.

My second point relates to justifying the funding in the revolving fund. Having spent 15 years in the new crop business, and I told the Board this in my testimony at Portland, watch out for the quick-fix syndrome. Getting expectations too high, it doesn't matter how high or how low, if they are unrealistic, it ends up in what I call anticippointment, and I think we need to avoid that like the plague with the AARC Center, because if you let that reputation develop, there may be no practical way out. It is kind of like I mentioned in my written testimony, the AARC Board only has one chance to make a first impression with the farmers of America, and I think that is my concern about the openness and making sure everything is above board, so there is no question—and this is not a reflection on the staff in any way.

I just think it is a sensitivity, and if you need justification for delaying the repayment to the revolving fund, I would recommend that you have some hearings or have the Congressional Budget Office or someone get good numbers on the cost of not doing AARC Center-type activities in the last 50 years. It will stagger everybody's imagination. I came up with $550 to $770 billion. That should help justify what the AARC Center is doing.

There are all kinds of reasons to want to tell people that cooperators are putting money back in the revolving fund. I don't want to downplay that, but these companies that are only a year and a half old, in spite of all they have learned, have a lot yet to learn, too. I have been working 15 years in a new area, and there are lots of stones that haven't been uncovered yet or turned over.

Senator DASCHLE. As a 1978 supporter of ethanol, I know a lot about disappointment, I will tell you that. [Laughter.]

I agree with what you say, but I must tell you that the scrutiny around this place is extraordinary, or it will be, and there will be opponents to this and a lot of other spending opportunities in the Federal Government. If we can't show that we are achieving the expectations of the authorizing language, regardless of the case we can make for not having done so for the last 50 years, we lose.

So it is really important that we are sensitive to that charter and to the expectations of the revolving fund as we go forth, because it all has to be looked at in balance. I would really be disappointed, if a few years from now we had nothing in the revolving fund, just because we have such great projects out there that one of these days they are all going to come around and do something. So we must achieve a balance.

Mr. O'CONNELL. If I may, Mr. Chairman, in regard to that point, this, in all honesty, is one of the more exciting aspects of this program. I can't point to any other programs. I know there are some payback programs, but many times the payback is done in a way that the Government just doesn't get its money back. I think if there is a successful project, one of the things we can point to is that, hey, we are different. If this thing is worthwhile, the private companies will pay the money back and we need to have some that give fairly soon payback, I agree with that.

But this is something I think the Board and I think, Lee, you would agree with this, something that we are giving a lot of thought to. We don't want to put all our marbles on the table right away, because, quite frankly, we want to learn a little bit while we are getting into this.

Senator DASCHLE. Mr. Carver, you wanted to say something?

Mr. CARVER. Yes, about the jobs and also the repayment of funding, taking ourselves as an example. We will probably be paying back the money within three to four years, by our pro forma projections. But we are also in this particular project providing 47 jobs right at the plant, and then there are also peripheral jobs in gathering and harvesting and transport and all of that.

Once this project is optimized and in production and we feel by probably two to three months, that may sound aggressive, but the way we are doing this is a little bit different—two or three months after this project is up, we have five other projects that are right now in one stage of contract and another waiting for this process to be proven on a commercial basis. So the accounting that AARC should have is not just the money that we pay back, not just the 47 jobs that we are going to be supplying in Fort Worth, but the follow-on investment and jobs that we are going to be providing that has nothing to do with AARC funding cashwise, but have everything to do with the participation in our early project, and that should be a part of the accounting.

Senator **Daschle**. I agree. What about all the unfunded projects? You have a lot of great projects out there that, if funding were available, would probably be funded. What other things can we do, and what kind of opportunities do those who were not funded have to come back for a second round of consideration?

Mr. **O'Connell**. Well, in response to the first point, generally, in regard to the more promising projects, and we have gotten a lot of inquiries and some very concerned, some very frustrated, we indicated that we very much welcome them to resubmit their projects, and then we are trying—and it has been very difficult for our small staff to do this—but in some cases we have been able to identify some other funding sources.

For example, we have with us today the AURI from Minnesota operation. Most of the States out there do have State economic development corporations, and many of them have not looked at agriculture as a real promising area to invest, let's just be very frank about it. We have had a chance at our hearings to have individuals from the Walla Walla Center in Iowa, from Indiana, from Kansas, and I know we have had others, and what we intend to do there, in fact, what they asked for is to allow them to see the projects that are in their State, to see if they would be promising.

So in some cases, we are providing them to the State economic development aspects. The more promising ones, we are allowing them to come back in. One of the main reasons why some of the really good projects weren't funded is that they looked at it in many cases as maybe just a development thing on the side of the university, and that is one very important aspect of the regional centers.

We will have circuit riders out there, as we call it, that will encourage somebody with a good idea, to try to match them up with a private sector partner in the financial community, and so forth, so that they can be successful in getting funds from the AARC Center. Because we look very strongly at the need to have a private sector partner, so many of the good ideas just didn't have a good strong private sector partner.

So there are some things that we have got to do. The regional centers were very helpful on this, working with the economic development corporations. Yes, we have told them that they can resubmit. What we are planning on doing this year is to get the process going a little quicker, and so we are going to put out our RFP early summer for next year's funding, in anticipation of funding.

Senator **Daschle**. Go ahead, Mr. McAfee.

Mr. **McAfee**. Mr. Chairman, I think Dr. O'Connell alluded to the fact that, certainly in addition to, in Minnesota, our agricultural research institute, within our State we have a number of other programs that can conceivably and have, in fact, through our programs come up with some matching funds. So as you go forward, I think there is a possibility you can have some very good projects with the Federal Government through the AARC program as participating, may only have 25 percent of the dollars in.

We like to see and insist on at least a dollar-for-dollar match in our programs. We do have a sliding scale, which takes into account smaller entrepreneurs, and that is something that people ought to look at.

I would just like to make one additional point that ties some of these thoughts back together. We are very enthused about the notion of regional centers and the prospect which they represent in terms of a vehicle to field those "circuit riders."

But, in fact, we have what we call technical service managers around rural Minnesota, and they are out there in the field working with those companies directly. So I think that also offers a great opportunity through these regional centers, as he alluded to, to address some of the concerns of Dr. Jolliff, and that is having a lot of key people out there in an advisory capacity and really bring the best and brightest minds forward.

I think if we let go and recognize we have got a lot of good ideas, a lot of good companies out here, a lot of good university people out there, and then keep the control and accountability of what goes on with those people in regional centers back here with this Board, then I think you will get a very nice balance and I think a greater chance of results and perhaps repayment.

Senator DASCHLE. Is there general agreement about the clarity that currently exists relating to the criteria to be used for the selection of the projects? The impression I have is that you have to be necessarily vague to a certain extent. I mean there is a big difference between the projects of Mr. Carver and Mr. Riebel, and so, obviously, in selecting those two projects, you had a lot of different reasons for making the selection. But I am wondering to what extent you can elaborate with some explicit language the criteria and the ground rules by which the competition is going to be considered.

Mr. O'CONNELL. Well, I think the best way I can do that, and I had it in my testimony, but our full proposal—and it was built to a large extent on the legislation, but it asked a whole series of questions, the typical things that venture capital would ask in regard to, from a business side, is this thing going to be successful. We had a whole series of questions on that. We had a whole series of questions on the impact of a proposed project, be it environmental, be it jobs, be it a number of other aspects.

This was 10 pages, and we tried to keep this as simple as possible. But in order to be in keeping with the legislation, and there is quite a large variation in the sort of things that we are supposed to consider in that legislation, but it was reflected in our full proposal, all of the aspects, and we were conscious of that. I don't have it right in front of me right now—I believe it is in this document right here—covers that stuff rather comprehensively.

But one of the bottom line aspects—and we could get some advice from you and other members of the committee on this, but the bottom line aspect, after we consider the environmental concerns, the value-added concerns, job concerns and these sorts of things, is that unless the Board felt that this particular project was going to be economically viable in the future, they shied away from it. In other words, that was kind of bottom line stuff.

You have to remember, we have on the Board a fair number of successful business people. In fact, Lee also serves on the bank board, do you not? So maybe you could comment on that aspect, so far as what the bottom line consideration of the Board in selecting these projects.

Mr. REEVE. Let me kind of allude to your first question first. I personally think that when we get the regional centers more involved, where we have people actually out in the field to kind of help, like I said in my testimony, kind of shepherd these projects through, they can go out and they can help these people answer the questions and they have a good understanding of what we are going to get it. Because, honestly, there are some of these projects that they are really not our kind of projects. They are good projects, but they are not the kind of projects that we fund.

Well, there is no use to people wasting their time on those kinds of projects. But on the good projects, they can be shepherded along, and also that will help with this proverbial problem of the big projects versus the small projects, because the big projects might have a whole staff of people that are experts at filling out proposals. The small proposals, the guy working out of his garage might have a great idea, but he has never filled out a form in his life. So if somebody can help him with that, then we can keep a lot of equity in there.

To refer to Paul's comment, you know, the AARC Center, as I envisioned it, was set up as a business and run like a business, and that is kind of what we are trying to do. We are trying to position ourselves in an area after the basic research has been done, but too early for a venture capitalist to come in. If we stay in that position, I think we can serve a need here. However, there is tremendous risk and we need to avoid as much of that risk as we possibly can.

Senator DASCHLE. Let me just point out a concern, and it is only a concern. I don't want it to sound like a criticism. I don't think I see enough written evidence of a methodology used by the AARC Board to access the expertise necessary to make the best decisions about these projects.

In fact, it would appear that you might even have a situation where as few as two people could be making a decision on a pre-proposal or on a proposal, and, I have got to tell you, that kind of a scenario could create some real problems in the future, and I hope you are going to take a good look at that methodology and be able to delineate not only what the criteria for selection is, but the methodology for reviewing those decisions, and come back at some point to this committee and lay out in some detail what that methodology is.

Mr. O'CONNELL. What you are asking for us is to go through in detail the methodology that we are using to make decisions and to come back to this committee and indicate very clearly how we accomplish those. We feel we have done that reasonably well, but I am sure there are areas that we can improve on, because we did have a number of outside reviewers, we did have a pre-proposal.

We had a form that they looked at and that is a matter of record, and we did a number of things.

But I think one of the areas where we may have been deficient is in showing real clearly what that process is and having it down on paper, and that is——

Senator DASCHLE. Well, I want it to be a prospective process, not retrospective only. I think that, while I completely understand the criteria will have to shift from one project to another one somewhat, and we understand the nature, and that is one of the strengths of this, the diversity of the projects.

Mr. O'CONNELL. Right.

Senator DASCHLE. But the methodology of accessing good expertise and ensuring good methodology and scrutiny ought to be the same. It doesn't matter.

Mr. O'CONNELL. We agree with that and we feel that we did that.

Senator DASCHLE. But I don't see enough evidence of it as to documentation as to that process and how it will be documented in the future.

Go ahead, Mr. Riebel.

Mr. RIEBEL. I think in our experience, I guess one of the founders before I came out here said that when you want to be successful, you listen to successful people. I think you have done very good in selecting your Board. They have Dr. Porter, who was one of the world class experts in material science, was on the Board who could analyze our projects. I think you picked good business people who can make those decisions with Paul and the staff, and I think if they don't have the experience, they are the first ones to step up and find the experience.

It is very critical in our company, because we could get research funds, but we are not bankable yet to fill that gap and to be able to move very quickly through that gap to keep our company moving. These business people—and I think the Board has very clearly done an excellent job—we have gone through a lot more paperwork, I am kind of surprised, because I almost think it is a little too bureaucratic right now, but they have done a very good job to move us through these things. I think they have demonstrated due diligence in both visiting and all the paperwork, and I think it was very refreshing that they could move through.

Senator DASCHLE. Spoken like a true project winner. [Laughter.]

Mr. Gain.

Mr. GAIN. I might just mention that we have visited with the members of the New Uses Council with Paul and members of the AARC Board about as we expand now the New Uses Council and encompass a wide variety of participants or potential participants in this whole process of categorizing, on the basis of their particular field of expertise a large pool of individuals that could be used by the AARC Board to draw on for expertise and maybe fine-tuning this process of evaluation. So we are in communication and that is an area that Mark is going to be working on to identify. A lot of the problem is who are these people and are they aware of the opportunities or are they plugged into the process.

Senator DASCHLE. Is my perception true that as few as two people could be making a decision, or is it broader than that

Mr. O'CONNELL. Oh, no, no, no. Like I say, let me just go through the process very briefly. We put out the pre-proposals and we asked only for four pages, and we indicated exactly what we wanted. We are going to do it differently the next time, because we are going to put spaces and they can only fill on that much space and so forth, and we want this much on this and so forth.

But we had four pages and then we had at least three reviewers, one from the business and one from the technical and then, depending on the project, it was either technical or business on the third one. So we had at least three in the staff review of every one of those 400 projects, looking as to whether the technical side, the business side and whether it should go forward for full proposal or reject, and so forth. So that was the first, and we had 70 different—and we got these names from the Board members, from a whole lot of people who have been dealing in this whole area for quite some time, we had quite a network working on the selection of those 70 reviewers.

Then next, the Board went and we met in Chicago and we met for 2 days, and the Board members were given each about 10, I believe, of the projects and then they kind of prioritized those and went down and indicated why they selected them in front of the other Board members. So every one of the projects that were selected from the 48 were gone through, not that every Board member read every one of the projects and the review, but they had to defend their selections in front of the whole Board before it was put on the list of 48.

So the Board was involved in the selection of the 48. Then one we got the 48, we had a rather extensive form that those 48 had to fill out so far as the information we needed, both from a business and technical and impact side, and then after that was put together, then at least two of the Board members looked at each one of those projects, and again we met for 2 days out in California and those two Board members had to defend that in front of the other Board members, and then we came up with the 20 that we are going ahead with.

So there were two members that went through it in detail, but they had to defend that in front of the other Board members. So in all honesty, the Board had a chance, I would say, to see every one of these in one context or another. So we had 70 outside reviewers, we had the Board give these a very close scrutiny, and any time there was a project where the Board member felt that there was some conflict of interest or they had a specified interest or whatever the case might be, they didn't work on that. They were excused from the room.

So in actuality, this went through a rather thorough review process before we got down to the 20, and then the last aspect was we went out on the site, and some of the 20 or 22 we won't be funding, after we made the site review. Some of those we won't be funding, because we may have seen some things on the ground or some technical questions that would raise some questions. Then we will be coming back and the Board will be meeting on May 19th. So that is what we did, and it was much more than just two, because a very thorough discussion between the Board members as to which projects should be funded.

Senator **Daschle**. Obviously, accountability is going to be crucial to our long-term success, and it is going to be critical that you are able to document as much as possible all of this and have an accountability system in place. It isn't just enough to be able to relate it orally. It is going to be a requirement that accountability be documented, and I know you are sensitive to that.

Mr. **O'Connell**. I am getting the message very loud and clear. [Laughter.]

We will document it and the Board will look at it and approve it, and when we get it done, we will be glad to provide it to you, Mr. Chairman.

Senator **Daschle**. Mr. Carver, did you have a point?

Mr. **Carver**. Just one comment. I don't know how we slipped through, but I actually had three Board members have to visit our site, and then we also went through a review by an independent university researcher on our technology.

Mr. **O'Connell**. I forgot to mention that and I am glad you brought that up, Mark. Some of the projects, especially in the lignocellulose, because we had—we must have had maybe 10 of those, if I am not mistaken.

Also in the biodiesel, we had a separate review, where we actually sat down and had those people come in for a full day and we had an hour, and Mark was one of those, so that we brought in technical people, and so we had a general review of those particular projects, because in some of these areas we just really didn't have a good feel, based on the paperwork, which ones are really outstanding and which ones aren't, and so we had a verbal review of those projects.

Senator **Daschle**. You mentioned the categories of recipients, and I thought I heard you say there was a farmer-owned cooperative as——

Mr. **O'Connell**. Yes, correct.

Senator **Daschle** [continuing]. There were two.

Mr. **O'Connell**. One ag co-op from Nebraska.

Senator **Daschle**. One ag co-op?

Mr. **O'Connell**. Yes, right, two nonprofits.

Senator **Daschle**. Does the breakdown by category of recipients relate somewhat loosely to the breakdown of categories of proposals provided?

Mr. **O'Connell**. I don't know.

Mr. **Roetheli**. Mr. Chairman, I think it would, if you did look at some private companies, but we had quite a number from the universities and, obviously, from the list that Paul noted, there are no universities, so you have to take that piece of it out. After that, I think it is fairly——

Mr. **O'Connell**. Yes, after you take the universities out, I think that would be true.

Senator **Daschle**. Dr. O'Connell, from time to time, you have heard the same criticism I have about the Board's domination, at least the accusation that the Board is somewhat dominated, by large-scale agribusiness. Just how would you respond to that? How do you put to rest these concerns about undue influences of larger-scale agribusiness?

Mr. O'Connell. I guess seeing the way the Board operates and the way they conduct their business, I sure am really comfortable with some of the Board members that do come from large companies, because they are successful and can tell very readily about something as to whether it is going to be successful or not.

One of the criticisms—and this wasn't only true in this experience with the AARC Board, but in other programs that I have been involved in—people will say, well, so-and-so is on the Board and he is going to have undue influence. But my experience has been in that situation, that when nine Board members are looking over each other's shoulders—a fair evaluation occurs.

Let me take an example: Marty Andrews from ADM is one that is generally pulled out, Jerry Caulder, Mycogen from California, a pretty good-sized firm. They are pulled out probably more frequently than others. But I can say quite honestly, so far as the deliberations of the Board and their undue influence, it just simply isn't obvious, and I see the merit of having somebody that really understands the industry, really understands what it takes to be successful.

It is more important than some of the concerns that some people may have, and those concerns are still going to be there. We have Lee, a relatively small operator compared to ADM, I believe, and others. Del Snyder is relatively small, and so forth. But I think there is a pretty good balance, but that concern is still going to be there. On balance, I would much rather have some of the really successful people on the Board, even though they are from large companies, helping to make decisions.

Senator Daschle. I would like to discuss a concern that I get at home and around the country, and one I know that you share, as well. The concern is this: Daschle, what you are doing here with AARC—I think we have to find new uses for a lot of different reasons, environmental and otherwise, but I am real concerned about whether anything is going to trickle down to the farmer, the producer. Will this AARC program really benefit a farmer?

It is hard to point to any specific part of this AARC program and say, well, this is directly going to benefit the farmer, except in that vague notion of creating additional demand for the product. But I think this is a concern out there that has been expressed in a number of ways, and I would be interested in your reaction to this concern and how we can effectively address it to ensure that farmers are real believers in what we are trying to do here.

Mr. O'Connell. That is a major concern and a number of ag economists have looked at that issue and they will say you create more demand and it just kind of comes back in equality and really the farmer doesn't get helped out and so forth.

I have spent a large part of my career in economic analysis. I have an MBA from Wharton School, and I have really given a lot of this a lot of thought. I think that unless you have a diversity of demand out there—and I would argue at this point in time that too much of our demand is in selling raw products overseas. Whereas, Europe has around 60 to 65 percent value-added kind of products, and we simply have got to do a whole lot better in that area.

But addressing specifically whether it gets back to the farmer, I think as we get into this and we have more products coming out of this kind of material, it is going to get very specific and you are going to develop specific kinds of seeds, you are going to develop a specific kind of cultural practice and you are going to develop specific kinds of alternative crops, they are going to go into a specific kind of product.

What is going to happen, I hope this is what happens, is that the farmers that are providing the kenaf example are moving in this direction. I think meadowfoam—that Dr. Jolliff could get to the point where he had serious market for meadowfoam, that the farmers would develop in such a way that they can honestly market and bargain for the prices that they need.

We don't want to get in the situation that the broiler industry has gotten into. We want to get in the situation that the Sunkist orange growers are in, where the farmers can honestly work together as a group and bargain for the specific kind of crops that they are growing with the buyer of that crop. I think that is what is going to happen eventually, and these kinds of specialty products that we have got around here are going to require very specific kinds of products come out of farmers. They are going to have to grow it. The things that we grow, corn for industrial use is going to be different than the corn that we grow for food uses and so forth.

Senator DASCHLE. Let me just say I think we foster a little bit of the concern, and I will just be as direct with you as I can. I read the beliefs and values section of the strategic plan, and I have got to tell you, I can see the corporate mentality there very well, and there is a reason for it. It should be there.

But what I can't see is a real delineation of the family farm mentality. It is not so evident. What is the family farmer going to get out of this? I really think we have to be as explicit in our determination, our intent—our stated intent—that this program isn't going to be designed just to create new business and a better corporate spirit in agriculture. But rather this AARC program is designed primarily and fundamentally to put more dollars in the pockets of our producers in a way that is not artificial, in a way that doesn't come through farm program subsidies and set-asides and all of the gobbledygook we have to put up with today. That is, this program promotes honest-to-goodness crop development for market purposes that ultimately can lead to better incomes for rural America, especially for farmers.

As I read the beliefs and values, I search for that kind of philosophy expressed and, frankly, I think it is pretty weak. I just think as we go forward, we are going to have to find ways to ensure that our stated intent is as clearly spelled out in that regard as it can be.

Mr. Gain.

Mr. GAIN. I just want to say I agree at least 1,000 percent with what you just said, and it is the reason that I and our organization have made the commitment, is for that exact reason. I can tell you that, like yourself, I spend a lot of time during the year meeting with farmers of all kinds, not just corn farmers, all over the country, and I can tell you that they agree, as you know, with what you are saying.

I was going to make the point some time this morning, before we were discussing, that farmers are interested in looking at new innovative long-term focused opportunities to create new market opportunities in this arena, and to get away from these traditional programs. They are looking for ways out. They don't like these programs. They don't feel comfortable with them. They also see that they are somewhat probably limited in terms of their duration and emphasis compared with the past.

The other thing I would like to tell you in terms of specific numbers, I think there was mention earlier of the big corn crop this year. Sure, we have a nine-plus billion corn crop and a billion-plus carryover, and in normal times we would have been looking at $1.50 corn. We didn't see it this year. We had pretty good corn prices, you know. We have got some problem areas. We have got a little pressure on here and there.

You know, if you look at industrial demand just for corn, and you can find this in some of the other areas, we well, in 1980, we were using 700 million bushels of corn for FSI in the industrial numbers. We don't have real good numbers, either. We have been working with DRS to try and get better numbers in some of these areas.

This last year, we are going to use close to 1.4 billion bushels of corn. That is double. If you take a look at that in comparison with what has happened to the export market, if you take a look at the simple growth line trend, which the corner refiners have put together, which shows a 2.3 billion-plus bushel use of corn in this area by the year 2000—2.3 billion bushels of corn.

I think that there is a lot more use in industry, not just ethanol, but in starches and all these other areas than any of us really realize at this moment, and I think it is one of the key reasons why we are looking at this location of supplies and demand and the reason this price is the way it is. So we are making progress, but you are exactly on target, and that is our interest, as well.

I don't think they are communicating it well enough, though. I think that is a big part of the problem.

Senator Daschle. I guess that is my point. I think the intent is there. It is just I don't think the delineation of intent, especially in the written message, is as clear as it ought to be, and I think it is something we can work on.

Mr. Carver, did you have a point?

Mr. Carver. Just another comment, how our particular project is directly affecting the family farmer. We have a project that will be our second project that we are already under contract for in Sacramento, California, that we use rice straw as biomass feed stock. Currently, in California, most rice straw is burned in the open field. There is a lot of environmental pressure to pull the open field burning out, which leaves the farmer with either a very, very severe disposal problem or don't farm.

Because of our presence and with that project there in the Sacramento Delta area, we are saving about 35,000 acres worth of rice-growing land by our ability to take that stubble out of the open field burn cycle, in addition to being able to get quite a few emissions credits out of the California Air Quality Commission. So it directly affects those rice farmers and their ability to not only continue their business, but also to have an extra income on that business.

Senator DASCHLE. Mr. Riebel.

Mr. RIEBEL. I have got a couple quick points. I stopped on my dad's farm on the way in, and he says with all this Washington stuff, I hope you have time to talk about the farmers sometime. [Laughter.]

I think we have had the opportunity to talk a lot. We have got a lot of support from the United Soybean, the checkoff program, and I think what AARC does to that and the farmer groups is it really makes a catalyst, which all of a sudden now we can get support from other groups in our State. We can get support from the checkoff program. It kind of brings together not only AARC, but it brings other people together.

I totally agree with Mr. Gains that industrial uses are much bigger than all of us think. I go back to the plywood industry, which was as huge, huge market for the farmer at one point of time, and definitively did drive prices. We lost a lot of the market. We just haven't looked back at history, and Henry Ford had that insight, too. So it is not new. It just needs to be directed and coordinated, and I think AARC really does that.

If you can show the farmer products, all the products that are here today, I think you are making a good-faith effort to really help them, so I think communicating with them is the key of what you are really doing.

Senator DASCHLE. Mr. McAfee, did you have a point?

Mr. MCAFEE. Mr. Chairman, I think there is no question in terms of secondary benefit, at least, that larger utilization of product will help farmers wherever they may be, particularly with community. I think we all know that those that will benefit first and foremost are those that own and control the company or cooperative or whatever that happens to be producing the product.

Let me suggest that, in the first instance, that is all right, because this is also about those that exercise ingenuity and entrepreneurship, and I think for farmers, beyond being the beneficiary occasionally of the trickle-down effect from a larger company, you will find that there are some farmers, maybe entrepreneurs start up their own business. Of course, farmer-owned cooperatives, those that are existing or start-up cooperatives, as you get into some of these alternative crops, there may be potential for a growers group, as Dr. O'Connell said, to not only grow and perhaps supply to some other buyer, but perhaps to own processing facilities, and so that is another dimension.

I think that leads finally to rural economic development. Rural economic development will occur most surely in a State like South Dakota, if the project happens to be based there. It will occur secondarily, if the benefit can trickle towards it. So I think probably the best thing to do is try to see I think those that are interested around the country how the AARC program can work for the local people and have all the means and mechanisms which I believe certainly is basically there to develop some good projects out there. I am sure if they are developed, the AARC Board, with the help of a number of people, will entertain those, and if they can compete well, they may well be funded. So that ought to be goal, is I think some home-grown projects that stand up technically and economically, those are the ones that are really going to result in your real economic development.

Senator **Daschle**. Dr. O'Connell.

Mr. **O'Connell**. Just to follow up on your comments, going on, I was concerned about this, quite frankly, as the type of projects that would come out after the review process, for the same reason that you had indicated.

I felt pretty good about it, because, as I indicated before, 14 of the 22 projects are small entrepreneurial firms. Now, they will be largely out in rural America. That makes a pretty darn good case that we are sensitive to projects that will be fairly close to where the farmer has grown his crop, to where the small community is. Only a small number of these are medium or large firms.

But you have got to have—let me just take with Arkenol, some of these, especially like in the plastics, starch or from the wheat one that we are talking about, Midwest grain, you have got to have a somewhat larger firm to develop these initial technologies, because you have got to have the skills, you have got to have the resources, you have got to get this thing far enough along so it is profitable, and a small firm simply cannot do that. They simply cannot take lignocellulose and make it into a successful operation. They simply can't take some of the ag-based, starch-based, protein-based type products, they simply don't have the backing, the expertise, the money to get those up and started.

So initially, we have to fund some projects that are going to get these up and serve as a prototype, and then they can be put out there. Because I think the sort of thing that Arkenol is talking about, you are talking about, as you indicated in your testimony, relatively small firms that are going to be doing that. So some of the technologies require somewhat bigger firms, or otherwise they won't get anywhere.

Senator **Daschle**. I understand all of that. You have all those challenges out there, but you also have a perception challenge.

Mr. **O'Connell**. Yes, I agree.

Senator **Daschle**. And don't underestimate the importance of that perception challenge.

Mr. Gain had his hand up for a while.

Mr. **Gain**. I would like to make two requests of you, since I have this opportunity. One is to encourage the USDA to fill Mark's old slot here as soon as possible. There are some good candidates in the wings I happen to know, and that needs to be filled, and that is a little plug for you.

Secondly, within USDA, we have a very well-kept secret over there in terms of the opportunity that the Foreign Agricultural Service and the Office of Economic Cooperation and Development has to contribute to our effort here domestically, and I would encourage you to encourage the USDA to use their international component to help feed this system.

There are a lot of things going on in Europe, in Asia and various other places around the world. We have a network of agricultural attaches and counselors and people who can feed this system for us and provide insight as to what others are doing or opportunities.

Technology: There are technology exchange programs that may be potential with the former Soviet Union or with the PRC or

Japan or other countries, as well. Technology exchange may be very important to our success. The biodegradable plastics technology came from Europe, you know. So I would encourage you to look also in that direction.

Finally, I would like to make the point that, in terms of the economics of many of these things, it has always been my contention—and this is a good example, because it is the deicer, it is about 23 çents a pound, made from $2.50 corn, compared with 2-cent salt. But the cost of salt on the environment is about 45 to 65 cents a pound, when you look at bridges and everything rusted out that we have.

The same thing with ethanol. If you look at the true cost of gasoline, it is $3 or $4 a gallon, and there are many, many studies that back that up. So don't talk to me about ethanol subsidies. It happens to be very common in my vocabulary, also. So true economics in looking at these projects is an essential part of our focus. Many of those are environmental costs, and many of them are very hard and fast costs, as well.

Senator DASCHLE. We are quickly running out of time and there is an additional set of questions I want to pursue, as well. I know you wanted to express yourself on something, Mr. Riebel, so go ahead.

Mr. RIEBEL. This will be real quick. Last Saturday, I had a person call me that was an unique development director for a small town in Texas, and all he wanted to ask me is, hey, if there are any of these economic development projects that look good, we are interested in having them locate in our community. You know, not everybody looks at it as maybe this isn't going to help the farmer.

Senator DASCHLE. A good point.

Mr. Gains' point is really related to my last series of questions. I think he is absolutely right, and I was glad to hear that you made a point of saying that you are going out wherever it may be to find new information and to coordinate as much as possible. I think we have to go abroad.

Mr. O'CONNELL. The regional centers are a real key to having eyes and ears out in the countryside.

Senator DASCHLE. I am concerned, also, about the coordination internally. I know you have divided up responsibilities, for good reason, among all the different USDA departments, assigning responsibilities to the primary research agencies, in particular. How are you coordinating all of that, and how would you describe your relationship right now with the primary research agencies?

Mr. O'CONNELL. Well, we have had some recent meetings. In fact, we just had one out in the Southwest, where we worked with the Agricultural Research Service and the universities through Cooperative State Research Service, and what we were doing was trying to help set up the regional center out there, get people involved. I am just using that as an example.

We use a tremendous number of university scientists, ARS scientists in reviewing the projects. We have a number of the projects that were proposed, like ARS projects, CRADA's and that sort of thing. It is rather free and flowing between us. We are putting this annual report out. We are sending this to all of the agency heads that are involved with this in the Department.

I think there is beginning to develop an understanding as to what we are and what they are, that we serve a unique niche. That question did come up, as I indicated, over in the House. We have regular meetings with these folks and I think it has been improving.

There was some reluctance to AARC being established in the beginning, I think as you know, Mr. Chairman. We are doing everything at this point in time to show that we want to be full partners with these people, so we are doing everything we can to move in that direction.

Senator DASCHLE. Are you facing resistance?

Mr. O'CONNELL. No. Once it became a fact and things are working, we have just had a tremendous amount of support. I don't sense any resistance at this point in time. I think there was resistance to getting AARC established, I will agree with that. But at this point in time, I don't sense that.

Senator DASCHLE. Are you satisfied, do I understand from what you said, that you are fairly satisfied with the degree of coordination that is going on right now?

Mr. O'CONNELL. I think it needs to improve, but it is improving considerably from what it was a year or two ago. It has gone like this. Like I say, a large part of the people that we work with in reviewing these projects, like I say, came from the traditional agencies. Those are the ones working on it, so we had no compunction, no problems. They were very outgoing and helping work with us on it, so I think it is definitely on the improvement and I sense that it will continue to improve.

Senator DASCHLE. Go ahead, Mr. Gain.

Mr. GAIN. At the risk of overstating the situation, I agree with Paul, but I think it is from a very low level. There is improvement. This has been a battle with the traditional research community from day one. They have tried to kill this project, I must be very candid about it.

I think they realize now that it is a viable, necessary option that they maybe have not paid attention to in the past, and they are starting to get some interest, but we have a long ways to go. They could be very helpful in this effort and I don't see a lot of that yet, although I see more of an openness to look at it. I understand that Paul may need to be a little more conservative in his comment on this subject, so I wanted to strengthen that.

Mr. O'CONNELL. I want to agree with what Jeff is saying. Among the rank and file of these agencies is a tremendous amount of support, and I would support the other. I think there could be more support at the higher levels, but I just feel that will come in time, but it is not as strong as it needs to be.

Mr. GAIN. It needs to come at this time.

Senator DASCHLE. Dr. O'Connell, given that the AARC program's need for cooperative assistance from the USDA research agencies will increase, I would like you to provide a set of criteria that this committee could use now for judging what level of cooperation must be achieved in a year from now.

Mr. O'CONNELL. I will do that.

Senator DASCHLE. That is what you call a softball.

Mr. O'CONNELL. I understand.

Senator DASCHLE. I really think it is important. My problem is—and I am not sure I know the questions to ask to see that it is getting done, because it is such a bureaucratic organizational challenge, to put it mildly. But I need some guidance, and you won't be the only one that will be asked to provide that, but I want your input.

Mr. O'CONNELL. Okay.

Senator DASCHLE. I am going to hold the Department accountable here, and we are going to make darn sure that there is cooperation. I don't care, I'll sit outside of Secretary Espy's office, if it takes that to get this done, but it is going to happen. And I know what the history is on this thing. I am very concerned in this formative period that we not get tweaked around, and I think it is important that you be as honest and forthcoming as you feel you can be. In any case, that is important to me.

Finally, let me just ask about State cooperation. There are some States that are doing some great things out there, as well. To what degree can the AARC centers cooperate, coordinate, and communicate with State activities?

Mr. O'CONNELL. As you know, in my previous position, I was Deputy Administrator in Special Programs in the CSRS, and myself and Joe Roetheli and Dan Kugler and a number of others. We had developed, I would say, a very good working relationship with the people out there that were working in the new uses area.

Again, I think if I could be so brave, I think that at the leadership out there, there was some reluctance in moving very strongly in the new uses area, for a lot of obvious reasons. Again, at the scientist level and a working level, we had developed a very good working relationship, and that is what we worked with. That is what I was responsible for and had developed a rather extensive network of contacts in universities, a very extensive network, and we have a list of all those people. In fact, we use a lot of them in reviewing our projects.

But the emphasis that has been given by the experiment stations to new uses and so forth has not been as strong, I don't think, as it probably should be, and I will leave it there.

Senator DASCHLE. Well, I would hope that we could show some progress in that regard, as well.

Mr. O'CONNELL. But the cooperation has been good. Like I said, I worked in this area in CSRS for some time, and tremendous cooperation. But as far as providing leadership for this area, it probably has not been as strong as it should be, somewhat similar to what it is in the Department.

Senator DASCHLE. Mr. Gain.

Mr. GAIN. Mr. Chairman, just a footnote. Many, many of the State departments of agriculture are very, very active in support of this area.

Mr. O'CONNELL. Oh, yes. I was talking about universities.

Mr. GAIN. This is another aspect of that. There has been a lot of leadership and a lot of resources put into it and will be in the future, I am sure.

Mr. O'Connell. That is an excellent point. The State departments of agriculture have been out front on this issue. This is their number one issue. In the meetings that they have, both regionally and nationally, it is at the top of their priority list. They see it as an absolute necessity to develop the kind of economic activity that is out there in all of the Midwestern States.

Mr. Gain. And you have Jay Swisher to give a lot of credit to, as well, and he is a member of the New Uses Council board and has been a real leader in this whole area.

Senator Daschle. I have an important meeting at 12:00, and I have many other questions that I know could be asked. Senator Conrad has asked that the record be left open to allow him to ask some questions in writing, which we will do. We may have some additional questions in writing to ask.

Let me close by thanking each of our panel members. You have been an extraordinary panel. We have learned a lot. I think we have a pretty good understanding of where we are right now, what our challenges are.

We will be continuing this oversight process. Obviously, we remain here to be a partner and to work with you to see that the job gets done. I am pleased with our progress. There is a whole lot more to be done, but, working together, I know that we will get it done.

Let me thank you, and the hearing is now adjourned.

[Whereupon, at 11:54 a.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

APPENDIX

QUESTIONS FOR THE AARC FROM SENATOR CONRAD AND RESPONSES THERETO, SUPPLIED BY PAUL F. O'CONNELL, DIRECTOR, AARC

I had very specific objectives in developing and enacting AARC, which I describe in the following questions. I'd like to ask how you are ensuring that AARC meets these objectives.

Question 1. I wanted to target assistance on the establishment of new uses commercialization businesses which would be located in rural areas, and which would create jobs and income in, and otherwise benefit, rural areas. How does your criteria for selecting proposals weigh the location of the project or business, and the number of new jobs created?

Answer. The evaluation of pre-proposals was considered in a matrix type format. A series of criteria were defined to rate each pre-proposal based on the general themes of sound management, good business prospects, viable technology, and beneficial impacts—with the key ones being job creation and rural economic activities. An example of this consideration for rural areas is evidenced by the fact that the Board selected three projects for funding on converting lignocellulosic (e.g., grasses, trees, etc.) materials to ethanol. The rural development implications of these projects were weighted more heavily once it appeared that these projects could survive without long-term subsidies. Lignocellulosic feedstocks are bulky and cannot be hauled long distances. Hence, processing will occur near where the material is produced thereby encouraging local economic activities.

Question 2. Do your criteria consider the quality of the jobs created, such as whether there will be an increasing level of challenge for employees as they gain experience, whether there is promotion potential and whether the pay is attractive?

Answer. The Board has considered jobs and qualitatively considered the types of jobs that would be created. The Board has not explicitly evaluated the promotion opportunity represented in each potential job.

The Board considered a whole series of criteria in evaluating proposals with the most important one being that the enterprise will survive on its own merits over the long term.

Question 3. How do you assess whether and how the new business will benefit a rural area?

Answer. By using a diversity of feedstock sources; entering into joint commercialization agreements—primarily with small firms that are located close to the raw material supply; and that produce a variety of products spread across rural America.

The 26 projects currently being negotiated for funding in 1993 involve 15 different plant and animal materials. They include animal fat, kenaf, waste paper, corn starch, soy meal and oil, industrial rapeseed or crambe, wheat, lesquerella, hesperaloe, grass straw, milkweed and lodgepole pine. Products being derived from these renewable materials include: composite building material that looks like polished granite; pulp; automotive windshield washer fluid using ethanol; biodiesel; grass mats; degradable polymers for food packaging, personal care items and medical products; biodegradable oil for operating equipment in a marine or forest environment; insulation material and a concrete form release agent.

Small business firms are involved in 18 of these projects; 1 is an agricultural cooperative; 2 are nonprofit organizations; 3 are medium-size firms, and 2 involve larger firms.

Question 4. I wanted to ensure that we only assisted commercialization projects which would truly benefit farmers by increasing the prices for raw agricultural commodities. Farmers and rural areas will not be helped by the commercialization of products which can only be competitive if the raw material is purchased at or below its cost of production. In your selection of proposals, do you assess what price a' company will pay for the raw agricultural or forestry commodity it will use to produce the new use crop?

Answer. Yes. That was a consideration and was evidenced in the pro forma budgets requested. It was a factor in the decision process.

The Board did its best to look for good business practices and projects that would help the income of farmers. Expanding demand for agricultural or forestry materials will tend to increase the price that farmers receive. For example, in 1991, non-traditional uses (such as sweeteners, ethyl alcohol, and industrial starch) of corn expanded over the previous 10-year period to the point where that volume now equals corn exports. According to the National Corn Growers Association, that expansion in domestic demand enhances price stability for farmers and reduces the likelihood of sharp revenue downturns due to international policy and trade disputes.

The Board also encourages farmer cooperatives to submit proposals. Hopefully the regional centers can help bring this about. We have one farmer cooperative project being funded with 1993 funds, plus another project where a group of farmers formed a company to develop a product.

As new industrial uses from renewable materials become more common, the AARC Center can encourage farmers to form marketing co-ops to negotiate a fair price for their raw material. This is already occurring with farmers that are growing crambe and kenaf.

Question 5. Do you reject proposals which won't raise commodity prices?

Answer. The Board did not specifically exclude proposals on this factor alone. However, if the Board felt that the project would be detrimental to prices farmers receive, this would have caused proposals to receive overall lower ratings. Fundamental economic principles indicate that greater demand for any commodity will increase prices—assuming other conditions remain stable.

Question 6. I wanted AARC to provide actual business financing, including loans and venture capital, to start up new uses business. In this first round of funding, I understand that you are only providing assistance through cooperative agreements, rather than entering business financing contracts. I understand that you are doing this at this time in order to move the program ahead while you develop the process for providing actual business financing. Please update me on your progress in developing the process for providing business financing, including loans, loan guarantees, interest subsidies and venture capital.

Answer. The Board has developed a tier of preferences for types of projects to fund as well as a hierarchy for methods of payback for the risk implicit in the AARC Center investment.

The nearer a proposed project is to commercialization without the applicant being able to attract other funding, the higher the Board rated that proposal with the exception of new crops. Projects that required much research generally were rated low unless the potential to assist agriculture and farmers was extremely high if the work succeeded.

The Board expects payback from virtually all successful projects. Hence, very few grants are in the portfolio from the initial request from proposals. The hierarchy for preference for payback is: (1) an equity position in the company, and (2) percentage of sales or a multiple payback scheme—both with a recognition of the investment risk—generally figured at 2.0 percent above long-term Federal Treasury rates. The AARC Center decided not to enter into loans at this time because of the amount of time required to set up all of the procedures and paperwork required for loans under the Credit Reform Act. The Board feels that the specific form of the funding arrangement is less meaningful than the availability of funds to meet the needs of the applicant to do the work and the payback that the AARC Center and therefore the taxpayers receive.

The initial portfolio will contain about equal numbers of projects where the AARC Center holds an equity position compared to projects were the payback is based on percentage of sales or multiple payback arrangements. The AARC Center does have three grants in the 1993 portfolio, representing three percent of project funds.

Question 7. I wanted to focus AARC's assistance on businesses, particularly small businesses, that did not have adequate resources to commercialize new uses on their own, but rather needed AARC assistance in order to leverage other sources of financing. Are you only funding business projects that cannot get adequate credit elsewhere and do not have adequate resources of their own?

Answer. We have no absolute assurance that applicants cannot get funds elsewhere. However, that question was directly posed to each applicant and if there was any indication the project would occur without AARC assistance, it was not supported.

Question 8. How do you evaluate whether a business cannot get credit elsewhere and doesn't have adequate resources on its own?

Answer. The AARC Center asks this as part of application and evaluates the response in the review process. Furthermore, the AARC Center serves as much more than just a source of financing. The Center attempts to be a catalyst and to allow applicants to use the AARC Center support for a project to be used to attract other financing. Several of the projects selected for funding are contingent upon the applicant obtaining other funding before the AARC Center's commitment is triggered.

The Board has learned just how difficult it is for small organizations to attract private sector financing. One applicant's form showed a return on investment of over 50 percent with less than a two-year payback and had three months of sales from a toll processing operation. Yet, the project was turned down by private financing to build an initial processing line.

Question 9. Do any of the proposals you have selected for funding include large companies as partners?

Answer. Yes. The Board selected some projects that have large firms involved. However, these are instances where small firms simply are not likely to be able to do the required work, yet the potential impacts on agriculture are so large they cannot be ignored.

The AARC Center has agreed to help Weyerhaeuser find a way to manufacture linerboard from grass straw in the Willamette Valley of Oregon. The grass straw poses a tremendous environmental problem as farmers have traditionally open-field burned it. On the other side, the western forestry industry has been hard hit by environmental and conservation concerns and needs a new feedstock to maintain plant operations in that part of the country. The help to Weyerhaeuser is only for collecting information on the cost, storage/quality, and reliability of supplying the straw. No small firm can undertake a project to make linerboard from straw, because the only practical way to incorporate straw into linerboard is in conjunction with an existing manufacturing plant and these are very large and capital intensive. On the other hand, if the technology can be proven with grass straw, then wheat, rice, oats, and barley straw can likely be used at other locations and the results of work on grass straw will remain in the public domain.

Another project has as a partner the engineering firm of Babcock & Wilcox. However, the lead organization is Arkenol, a small firm. The project proposes to be the first commercial size plant to process lignocellulose into ethanol, a project with huge ramifications for agriculture, the American farmer, and conservation programs. Arkenol's funding from the AARC Center also is contingent upon getting other financing and is tied to meeting industry performance standards during start-up on grain feedstocks. Arkenol will use the contingent commitment from the AARC Center to leverage other funding for a project with total investment of over $40 million.

Midwest Grain, Inc. is a mid-sized firm developing polymers from wheat which has significant implications for the entire wheat producing areas of the country—as it would provide a high-value market for wheat outside of the traditional food and export markets.

Another example is where the AARC Center is funding Biotechnology Research and Development Corp. (BRDC), a consortium of partners that includes a small firm and three large firms. Success in commercializing encapsulated pesticides would provide relatively large use of corn flour, reduce chemical pesticides application, leverage large companies; this project is envisioned to be commercialized in rural areas and BRDC would license the technology to other companies.

Question 10. I wanted to use AARC to link the myriad of public and private programs and resources around the country which can contribute to the establishment of new uses businesses. While separately these programs cannot provide all the kinds of assistance and financing necessary to commercialize new uses, together they are a powerful resource. What are you doing to link up these resources and programs?

Answer. We currently are sharing a number of the applications the AARC Center received with the Rural Development Administration (RDA) for their consideration. We think there are meritorious projects that the AARC Center did not fund that should be of interest to RDA. We also shared some of the more promising projects with economic development corporations in the States, and with the wheat, corn and soybean commodity utilization committees.

The Board recently announced the formation of the initial two regional centers. The Board expects the regional centers to play a key role in linking resources and programs with a broad array of organizations.

Question 11. You have not published a full description of your criteria and selection process in Federal regulations for public comment. Do you intend to do so, and if so, when?

Answer. The Board felt that the law—combined with the Strategic Plan, request for pre-proposals and the full proposal questionnaire—provide sufficient specificity for selection criteria. Those who read and complete these documents should understand what is desired and how their proposal will be judged.

The AARC Center specified four key criteria: Sound management, good business prospects, viable technology, and beneficial implications. The next request for proposals will contain more specific evaluation criteria based upon what was learned in the initial evaluation of proposals.

With the establishment of the first two Regional Centers in 1993, a full description of the criteria and selection process will be published in the Federal Register for public comment.

PREPARED STATEMENT OF RON ALJOE, NEW PRODUCTS MANAGER, WESTERN TEXTILE PRODUCTS COMPANY, DALLAS, TX

Mr. Chairman and members of this subcommittee, I would like to thank you for the opportunity to appear before you today and present my views concerning USDA's Alternative Agriculture Research and Commercialization Center. As you know, this Center is administering the funds being made available for new and innovative uses of agricultural products.

The fact that the USDA has recognized that our natural resources have the capability to stimulate new products for commercialization is exciting. It is obvious that this structure of product development can create a win-win situation in the economic chain of cradle-to-grave product consumption.

Today, in business, the cost of product development is very expensive. The risks and reward factors are extremely high. There is a 1 in 100 chance for business success. So, just to commit an organization to consider new product development is a significant challenge. These steps begin with an idea being analyzed, prototypes manufactured, testing performed, equipment purchased, and finally the product is marketed and sold. Anywhere along these stages the product can fail. It is generally known that 75 percent of new ideas never make it beyond the second stage—being analyzed. Only about 10 percent of new products developed go beyond the development phase which require the use of all five resources of a company: Employees, finances, machines, space, and time.

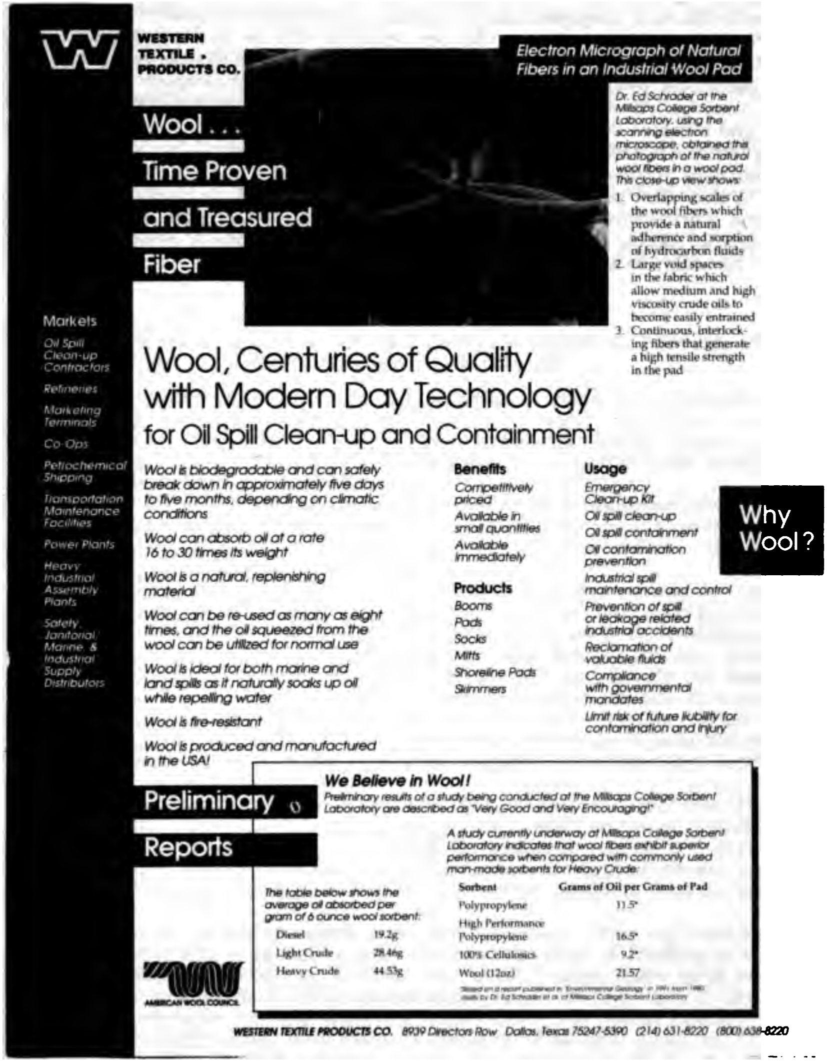
Industry is starving for innovative products that are competitively priced and environmentally friendly. Products that have a negative effect on the environment are coming under greater scrutiny by the Federal Government. And as new regulations are written, which increase the cost of doing business, fewer products are available from the market. This drives the need for innovative products that do not have these kinds of problems.

The AARC Center in my opinion is absolutely necessary. Congress must continue to fund the Center and even significantly increase the level of funding to commercialize new agricultural products. Without the AARC Center, many good and commercially viable new agricultural products would never see the light of day. Western Textile is currently working with the AARC Center to obtain funding for the development of using natural wool fibers in the area of oil spill clean up. The wool used in oil spill clean up technology is very low quality wool which currently has little to no marketable use. A new market will literally be created for wool that previously had no value. I distributed along with my written statement, which was submitted to this subcommittee, copies of a brochure which explains this new and innovative use of a naturally replenishing agricultural product.

It is enlightening that the AARC Center is seeking to identify private industry that wants to utilize natural fibers that are replenishable and capable of competing with man-made fibers in many markets. The AARC Center programs are absolutely essential in providing opportunity to many products that would otherwise never be commercialized because it is so difficult for small companies to obtain financing. The funding assistance from the AARC Center will greatly help the commercialization of industrial products made from agricultural and forestry materials. Whether the current level of funding is adequate (which is at $10 million) can only be measured by the sheer number of proposals submitted that have high potential of success. One must remember that whether you are developing hi-tech products or low-tech products, you do not eliminate the functions I previously mentioned to develop and commercialize new products.

Is the AARC Center and the grant program worthwhile and providing a meaningful return to the U.S. taxpayer? In my opinion, yes. Small companies like Western Textile Products and our partners that are working with us in developing this new oil spill technology using wool, are the kinds of companies that provide new jobs through successful products. At the same time, a successful program will provide greater income to rural America and to the producers of natural fibers. As these new jobs and invested dollars multiply we are stimulating the economy. But without programs like the AARC Center these kinds of opportunity would be missed.

Mr. Chairman, in closing, let me encourage this subcommittee to not only continue funding this vital program, but also, consider increasing its magnitude. It is a needed and worthwhile Federal program that helps provide jobs and income to rural America. Again, thank you for this opportunity to appear before you today and I will be happy to answer any questions that you may have.



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*Based on a report published in 'Environmental Geology' in [illegible] from 1980 tests by Dr. Ed Schrader et al. of Millsaps College Sorbent Laboratory

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PREPARED STATEMENT OF WAYNE NELSON, PRESIDENT, COMMUNICATING FOR AGRICULTURE, BLOOMINGTON, MN

Chairman Daschle, members of the subcommittee, I thank you for the opportunity to present to you the views and concerns of Communicating for Agriculture (CA) regarding the development of the Alternative Agriculture Research and Commercialization Center and the whole field of new uses of renewable resource products from agriculture.

My name is Wayne Nelson. I am a grain farmer from Winner, South Dakota. I have served on the board of directors of Communicating for Agriculture since 1985, and I was elected president of CA at our annual meeting this month. CA is a nonprofit association representing farmers, ranchers and small businesses in 48 States.

Communicating for Agriculture has been actively working in support of the development of the new nonfood industrial and consumer products made from agricultural materials for many years. In our view, new uses holds perhaps the best opportunity on the horizon for long-term, sustainable improvement in the agricultural economy. It is not an easy path. "New uses" is a big concept—a vision that agriculture can serve an entire new role beyond food and fiber production in ways that will benefit the world's environment. There are many risks involved in developing new products, new crops and in breaking into new markets. But in our business, the best opportunities often require risk and hard work. They also require cooperation and creative thinking. And that is the heart of our message today.

CA has taken three approaches in our work to support new uses development:

1. Work to create and strengthen public-private partnership programs between Government and the private sector. CA has been a strong supporter of the AARC program and, like many groups, we have high hopes that with adequate resources, over time we will see some major success stories. We've also supported the creation of State programs that can work in this area to assist rural entrepreneurs.
2. Work to get all of agriculture involved in new uses development. CA is a founding member and is actively involved in the New Uses Council, a coalition organization including agricultural organizations, agribusiness, research institutions, Government agencies, small businesses and industry users.
3. Work to promote and communicate to the general public and industry about the tremendous benefits—both environmental and economic—that can come from new renewable resource industrial products from agriculture. We are pleased by the heightened awareness and interest we see in this area. But the new uses movement must strengthen its educational effort. And our message must be credible and accurate.

Our biggest concern is that we need programs that work to support development from the bottom up. *For CA, the real promise of new uses lies in their potential to improve net income of farmers and stimulate new jobs and businesses in rural areas. For new uses to work to revitalize rural America, we need to be addressing ways to help see that value-added income gets in the hands of those who need it the most.*

That's not to say there should be any brakes put on new uses development by big agribusiness firms and industry processors in and out of rural areas. The new uses field, while showing tremendous promise with new products coming onto the marketplace, is still in its infancy and just starting to show some measurable economic benefit. Ways should be found to assist formation of new growers associations and cooperatives where there is promising interest, assist rural entrepreneurs, and encourage potential joint ventures between rural businesses and nonagriculture industries that can market the products.

As the subcommittee reviews the progress of the AARC program to date, I urge you to assess not only the first projects chosen by the Board for support funding, but also the number of other viable projects close to commercialization that the AARC Board was not able to fund. You should try to get a realistic assessment of funding needs of viable projects, and monitor this demand, which will change, as time goes on. We also encourage the AARC program to look for ways to provide other assistance to unfunded projects, such as referring to other public and private support programs. Ongoing review to monitor the integrity and viability of projects funded by AARC also needs to be carried out. We hope the AARC program is provided adequate resources and support to carry out these functions.

Beyond review of the AARC program, we have three recommendations:

(1) Explore other steps that can be taken by USDA, including agencies other than AARC, to strengthen and participate in the whole concept of new uses product development and commercialization.

—Under the past administration, there was supposed to be an interagency task force trying to work together to advance new uses. This is a good idea, and it would be good to continue to try to expand and improve internal cooperation in USDA.
—USDA's Economic Research Service has announced it will soon issue its first Situation & Outlook Report on Industrial Uses of Agricultural Materials. This is a very positive development. It will provide private industry sectors a stronger ability to measure market opportunity.
—It would be particularly helpful if an interactive relationship could be established between AARC and other departments. Set up a system where contacts AARC receives from the private sector could lead to problem-solving support from any of several agencies, particularly the Agricultural Research Service and Cooperative State Research Service on the technical side.
—USDA could also expand its effectiveness by activating the rural development agencies on this field. For example, it would be helpful if the Agricultural Cooperative Service could provide field support for organizing new grower co-ops in new alternative crops or new uses processing. ACS seems to serve a more analytical and informational role lately. A hands-on role might prove to be more effective in this case when agriculture has an opportunity to break into entirely new markets.
—Rural electric cooperatives have been increasingly working in rural development projects. This could be a natural tie-in for them—to be able to provide low-interest loans for new uses manufacturing facilities in rural areas they serve.

We're not suggesting we need to find new roles for these agencies. They serve vital roles now. But it is unrealistic to tackle this job—realizing the tremendous economic potential that new industrial uses hold—with just a fledgling new program like AARC with only a $10 million annual budget for commercialization work, plus ARS' limited budget for research.

This is a big, important job. New uses can yield huge long-term economic benefits for the country. We have limited Federal budget funds available, so let's use the resources and programs we have as effectively as we can and reprioritize where necessary.

(2) Develop AARC into a lean, but larger program with regional centers that can be truly *responsive* to contacts and requests from the private sector—not limited to providing matching fund support, but also with technical assistance that AARC can tap into in other agencies, in and out of USDA.

Ideally, an AARC regional center should be a resource center able to provide guidance and access to other sources of expertise in the region, when it is contacted about a potential new product for commercialization that doesn't involve a request for support funding.

If AARC follows the path taken by Minnesota's Agricultural Utilization Research Institute, a similar State program, it will start out providing grant funding for some promising projects, then gradually switch to a more hands-on program that provides technical assistance, as well as more standardized matching fund programs. AARC staff members have provided very valuable technical support to projects they have been involved with in the past, in their work in CSRS. But AARC will need enough resources for its regional centers to be able to do this.

The point is, we'd prefer that AARC not put all of its limited funds into a handful of major projects, but gear itself to building cooperative relationships with other agencies and State/regional resources to be able to assist more projects.

(3) Encourage departments in the Federal Government to work together with USDA to advance new uses development.

We have seen signs of good cooperation, particularly between USDA and the Department of Energy, in this field—notably in organizing the first Biobased Products EXPO. EPA, SBA and the Department of Commerce also joined in with the New Uses Council in this project. But more interagency, cooperative effort could pay off.

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